THE IRON TRADE REVIEW

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THE WEEK IN IRON CIRCLES.

THE MARKET AT LARGE.

Midsummer quiet is upon the iron market, and in addition the special deterring influences that have controlled buyers in the past few months. The effect of the good purchases of rails and the inquiry pending has been a continuing favorable factor, and railroads show no evidence of a slackening in their requirements of materials of all descriptions. But with the shutdowns of mills that come in the early part of July, and the accompanying inventories, there is a general agreement in the let-alone policy, which makes surface indications of little significance. There is nothing in the condition of consuming industries, apart from the strikes affecting New York building operations and the interruptions from similar causes at a few other centers, that points to a falling off in the rise of iron and steel. Larger capacity to produce is in evidence in a number of lines—notably pig iron (but here chiefly for steel-making uses); but the use of foreign iron and steel, of which much more than a million tons has come in within the past twelve months, will now give place to larger consumption of domestic products, so that there appears no immediate likelihood of domestic production becoming markedly excessive. What has been said over and over as to the running out of old contracts and the using up of material in the hands of buyers becomes increasingly a factor in the situation as each week passes with no general resumption of buying. As in all such times of hesitation, the exact balance between production and consumption is difficult to judge. The Southern coal miners' strike may be ended at another conference which is expected this week or next; on the other hand it may be prolonged, and in that case the position of pig iron producers would be strengthened. No interruption to furnace operations has taken place as yet, apart from one stack which takes this opportunity to make repairs; but by another fortnight the failure of the coke supply would compel some furnaces to stop. Meantime the market for Southern iron has shown some further weakness, but it does not appear that the furnaces have made the extreme low prices named in rumors of the past week. The addition of further furnaces to the active list is a matter of the near future, but others, smaller and with high assembling and operating cost, are likely to be out of the running when prices settle finally to the basis on which business can be done. The strike fever has not yet run its course among machinists and molders, and there are indications of the beginning of the campaign of the former for an 8-hour day and an advance in hour's pay. It scarcely seems likely that organized labor will refrain from hastening the end of prosperity by pressing for further advances. Already the burden of high labor cost is telling in the case of a number of blast furnaces. The question is how long the high wage structure can be kept from serious breaks.

PITTSBURG.

OFFICE OF *The Iron Trade Review*, 429 PARK BUILDING, July 8.

The iron market is very quiet, having entered what is usually one of the two dull seasons of the year. A number of plants are closed down for repairs and inventory, and a great many people are away on vacations. There has been no change of any importance in prices of any line, pig iron being held as formerly quoted and finished material being down to base prices in all cases except tin plates. Specifications have been quite good on plates since the first of the month, but only fairly satisfactory in shapes and merchant bars. The current business in all these lines is remarkably good, and proportionately much better than specifications against contracts.

The coke market has firmed up considerably, and furnace coke is a shade higher than it was. It is increasingly difficult to get strictly Connellsville furnace coke, many furnaces which during the shortage used any coke they could get now turning to standard Connellsville, with the result that they find it somewhat difficult to secure.

Pig Iron.—A number of steel works are down for changes and repairs, and are not buyers for July, while others have already contracted, so that altogether the market for Bessemer and basic is very quiet. Quotations are nominally unchanged, the Valley furnaces holding quite stiffly to former prices. Occasionally an odd lot is offered by an outside furnace at a slight concession. In foundry there is some buying, but very little. Nothing definite on the possible molders' strike is expected until Monday next. We quote prices unchanged as follows:

Bessemer, Valley	$18 60 to 19 00
Bessemer, Pittsburg	19 45 to 19 85
No. 1 Foundry	19 00 to 19 50
No. 2 Foundry	18 50 to 19 00
Gray Forge, Pittsburg	18 50 to 18 75
Chilled Basic, Valley	18 75 to 19 00
Chilled Basic, Pittsburg	19 60 to 19 85

Steel.—Middlemen are doing very little in crude steel, as a couple of the large mills are sellers of limited quantities, and are supplying most of the demand. There is quite a fair movement, and on good sized lots $28 for Bessemer and $29 for open-hearth, at mill, can be done. There has also been a fair movement in sheet bars, at about $2 advance over billets. We note some very small lots of open-hearth sheet bars sold as high as $32 at mill, Pittsburg district. Wire rods are quiet at $36.50 asked.

Ferro-Manganese.—The market is unchanged, imported 80 percent being quoted at $50 for large lots, delivered anywhere east of St. Louis, up to $52.50 for ordinary small lots.

Muck Bar.—On a desirable order mills would quote about $32, delivered Pittsburg, for good local grades. The market is very quiet.

Skelp.—The market continues strong for large sizes, but the ordinary run of skelp is dull. We quote on ordinary lots: iron, grooved, 1.90c; sheared, 1.95c to 2c; steel, grooved, 1.95c; sheared, 2c.

Bars.—Specifications are fairly good on old contracts, and there has been a good lot of new business booked, but the total comes far from keeping the mills fully occupied. It is well settled that there is too much capacity to permit mills going to their rated output. Prices are well held. In iron bars the situation is quiet as many mills are out for repairs and inventory. Odd lots are offered at 1.75c to 1.80c, delivered Pittsburg. The Eastern mills are quoting 1.70c at mill and Western mills from

1.65c to 1.70c. We quote the market as follows: Bessemer steel bars, 1.60c; open-hearth, 1.70c; plow beams and cultivator beams, 1.60c, net; channels, angles, zees and tees, Bessemer, under 3 inches, 1.70c; over 3 inches, 1.80c; bar iron, 1.80c, Youngstown, or 1.84¼c, Pittsburg, with freight added to point of delivery from Youngstown. The following differentials maintain: Less than 2,000 pounds of a size and not less than 1,000 pounds, 10 cents advance; less than 1,000 pounds of a size, 30 cents advance. Hoops and bands are quoted at 1.90c, full extras, in 250-ton lots and over, and 2c in less than 250-ton lots.

Pipes and Tubes.—Conditions are very strong indeed, with mills filled up and only with difficulty making satisfactory shipments. On the large sizes they are booked for several months ahead, in some cases to the end of the year. We continue to quote as follows in carload lots to consumers, f. o. b. Pittsburg, plus freight according to Tube Rate Book to destination:

MERCHANT PIPE.

	Steel Pipe. Black. Percent.	Steel Pipe. Galv. Percent.	Wrought Iron Pipe. Black. Percent.	Wrought Iron Pipe. Galv. Percent.
⅛, ¼ and ⅜ inch	68	58	65	55
½ inch	70	60	67	57
¾ to 6 inch	75	65	72	62
7 to 12 inch	69	59	66	56
Plugged and Reamed				
1 to 4 inch	73	63	70	60
Cut 3 to 6 feet				
⅛, ¼ and ⅜ inch	63	52	60	49
½ inch	65	54	62	51
¾ to 6 inch	71	60	68	57
7 to 12 inch	65	53	61	50
Cut 6 feet and longer				
⅛, ¼ and ⅜ inch	64	53	61	50
½ inch	66	55	63	52
¾ to 6 inch	72	61	69	58
7 to 12 inch	66	54	62	51
Extra Strong Plain End				
⅛ to 8 inch	67	57	63	53
Threads only	66	56	62	52
Threads and Couplings	65	55	61	51
Double Extra Strong Plain End				
½ to 8 inch	59	49	55	45
Threads only	58	48	54	44
Threads and Couplings	57	47	53	43

NOTE.—Orders for less than carload will be charged at 12½ percent advance. Extra and Double Extra, Strong Cut Lengths, lower random discounts by 10 percent net for 6 feet and longer, and 15 percent net for 3 to 6 feet.

BOILER TUBES.

Steel.

	Percent.
1 to 1½ inches	45
2¼ to 5 inches	62½
1¾ to 2¼ and 6 to 13 inches	52½

Iron.

	Percent.
1 to 1½ inches	36½
2¼ to 5 inches	45½
1¾ to 2¼ and 6 to 13 inches	35½

CASING.

	S. and S. Percent.
2 to 3 inches	58
3¼ to 4 inches	60
4¼ to 12½ inches	63

Rails and Track Material.—We are advised this week that orders placed for 1904 with the rail mills aggregate considerably over 500,000 tons. Light rails are in good demand, but prices are hardly as good as they were some time ago, when certain large producers were paying little attention to this line. We quote: Standard sections, 50 pounds and over, in lots of 500 tons and over, $28; car lots and less than 500 tons, $30; less than car lots, $32; light rails, 8 pounds, in carload lots, $39; less than carload lots, $40; 12 pounds, $38; 16 and 20 pounds, $36; 25 to 40 pounds, $36. Track materials: Spikes, 2.15c to 2.20c; track bolts, square heads, 2.05c; hexagon heads, 2.65c; fish plates, 1.60c on orders accompanying large rail contracts, otherwise 2c to 2.10c is asked.

Plates.—There is quite a lot of new business going which helps to make up for some slackness in specifications. Mills are well satisfied with the amount of business so far this month. Official prices are strictly maintained as follows: Tank plates, ¼-inch thick and up to 100 inches in width, 1.60c at mill, Pittsburg; flange and boiler steel, 1.70c; marine, ordinary firebox, A. B. M. A. specifications, 1.80c; still bottom steel, 1.80c; locomotive firebox, not less than 2.10c, and it ranges in price to 3c. Plates more than 100 inches 5c extra 100 pounds. Plate 3-16-inch in thickness, $2 extra; gauges Nos. 7 and 8, $3 extra. These quotations are based on carload lots, with 5c extra a hundred pounds for less than carload lots. Terms, net cash, in 30 days.

Structural Material.—A fair amount of new business is going to fabricators, but no very large contracts. Specifications to mills are fairly good. Official prices remain unchanged as follows: Beams and channels, 3 to 15 inches, 1.60c; 18 to 24 inches, 1.70c; tees, 1.65c; zees, 1.60c; angles from 3 to 16 inches, 1.60c; universal mill plates, 1.60c.

Sheets.—The market is evidently in very good shape, as we note one order of about 1,000 tons of the most desirable specifications placed with a mill for delivery in the next two months at but a nominal concession from the regular price. On galvanized sheets it is still possible to get an extra 2½ percent off in some quarters. We quote official prices on contracts for 500-bundle lots and over as follows: No. 28, 2.75c; No. 27, 2.65c; No. 26, 2.55c; Nos. 22 and 24, 2.45c; Nos. 18 and 20, 2.35c; Nos. 14 and 16, 2.25c; Nos. 10 and 12, 2.10c to 2.15c. Galvanized: No. 16, 2.60c; No. 18, 2.85c; No. 26, 3.35c; No. 27, 3.60c; No. 28, 3.85c; No. 29, 4.35c; No. 30, 4.50c.

Wire and Nails.—There is nothing noteworthy in nails or wire, prices being quite well held and there being the usual run of business for the season. We continue to quote: Wire nails, carload lots, to jobbers, f. o. b. cars, Pittsburg, $2; plain wire, carload lots, $1.90; barb wire, carload lots, $2.30; staples, carload lots, $2.20. Galvanizing, 30 cents extra. Carload lots to retailers are held at 5 cents advance in all lines, and on less than carload lots a further advance of 10 cents is charged. Steel cut nails are quoted as follows: Carload lots, $2.15, and less than carload lots, $2.20, f. o. b. Pittsburg, plus freight to point of destination. Iron cut nails are $2.25 in carload lots and $2.30 in less than carload lots. Terms, 60 days, less 2 percent off in 10 days.

Merchant Steel.—The market is inactive, as usual in the summer. We continue to quote prices as follows: Turned cold rolled and ground shafting, 47 off in carload lots and 42 percent off in less than carload lots. Tire steel, 2.15c to 2.25c; spring steel, 2.25c to 2.35c; toe calk, 2.30c to 2.40c. Tool steel is quoted 7 cents and upwards, according to the grade.

Spelter.—The spelter market shows no change in prices, and we continue to quote 5.63½c, Pittsburg, for prompt or July shipment from the West.

Old Material.—Very few sales have been made, and the market is still not far from nominal. Current quotations have now largely discounted the decline in pig iron and there may be better buying in the near future. We note a few sales of small lots of ordinary melting stock at $20, with some crop ends at $20.50, while No. 1 cast scrap is quoted at $18 and sheet scrap $16.75. Steel works still have some scrap coming to them; foundries are not buying, as their trade is dull, and they do not regard their pig market as settled, while most of the iron mills are shut down for inventory and repairs. All this naturally makes a dull scrap market. In some cases negotiations have been commenced on contracts for rolling mill scrap for the second half.

Coke.—The feature of the coke market is the stiffness of strictly Connellsville coke and the wide range of prices on various outside cokes, which run over 1 percent in sulphur. While furnaces took such coke during the scarcity, as it was better than none, they are now looking around for standard Connellsville and find comparatively little obtainable. Standard Connellsville furnace coke is quoted at $3, and it would be hardly possible to shade this price much, while outside coke is $2.50 to $2.75. Strictly Connellsville 72-hour foundry coke is $3.25 to $3.75, according to size of contract, while outside foundry coke is a shade less.

CHICAGO.

OFFICE OF *The Iron Trade Review*,
1115 MONADNOCK BLOCK, July 7.

The second half of the year has been ushered in, with the markets generally quiet. There is almost universal holding back by buyers, solely through fear of falling prices. This course has been maintained for so long a

time that possibly it has affected the consumption of the metals unfavorably. But the sentiment of the trade is improving. Sellers not uncommonly remark that the consumers who are now refraining from the purchase of iron and steel will soon be scrambling for material. If the turn once comes and if the withholding of orders has extended back to the consumer, it is easy to see what a flood of business may be thrown on the market in a comparatively short time. However, that condition is purely conjectural at this writing, for there is no indication of a general buying movement, while there is anxiety for orders from some mill owners who require the exercise of considerable self-restraint to keep from seeking the same at whatever inducement may be necessary to secure them. The absence from the city of many business men because of the recent holiday has broken in on the past week's trading and the general condition reported is that trade is quiet, though, as stated above, there is a more hopeful feeling concerning the trade of the near future.

Pig Iron.—It has been the common practice for a buyer of pig iron when he negotiates a purchase, to arrange for the early shipment of the iron. Few foundrymen are buying, most of them in fact are supposed to have in stock a good tonnage of iron, but when they do buy it is because they are not of the majority who are thus favorably provided with iron. And it is the large consumers who are doing most of the present trading. One 1,000-ton lot of No. 3 foundry was sold for pipe manufacture at $13.75, Birmingham, for use during the next sixty days. The buying is mainly of grades essential to mixtures. There have been few of these 1,000-ton transactions but almost every seller has taken a few carload lots at least. A few have been placed at the established schedule of prices for Southern product, $15, Birmingham, for No. 2 foundry, but the great majority of orders have been placed at a dollar or more below that level. The market in fact has within the past few days developed some further weakness. Uncertainty is in the air and in the prices quoted. There are rumors that $13.50 was quoted at Detroit for a lot of iron; another that $13, Birmingham, has been named by one Southern furnace. There is more or less haziness about these reports but the temper of the market is unmistakably soft. It is said that the Southern pig iron producers will hold a conference this week or next and that at that meeting some action may be taken in reference to a further reduction of prices. There are intimations that the reduction may be radical but that is of course purely theoretical. The coal miners of Alabama, who went out July 1 pending a settlement of the wage scale, may be a factor in the situation, if the wage agreement is not fixed up promptly. The men demanded an advance in wages, which would of course mean an advance in the cost of material and perhaps fall most heavily upon those furnace interests that buy instead of make their coke. In fact the suggestion of a suspension of mine activities does not fall upon the selling trade with that dread with which it might have been received a year ago. The large implement order still hangs fire, though there are still reports that it may be closed at any hour. The wide advertising which this pending contract has received from the trade press, has brought it to the attention of the entire pig iron producing world and there is among many furnace interests a scramble for the business, some conservative interests not participating. Local irons are sagging a little in conformity to the downward tendency of Southern irons, but there does not appear to be much Western iron for sale. Prices are as follows:

Lake Superior charcoal	23 00 to 24 00
Local Coke Foundry No. 1	19 50 to 20 00
Local Coke Foundry No. 2	19 00 to 19 50
Local Coke Foundry No. 3	18 50 to 19 00
Local Scotch Foundry No. 1	19 50 to 20 00
Southern Coke No. 1	18 85 to 19 85
Southern Coke No. 2	18 35 to 19 35
Southern Coke No. 3	17 85 to 18 85
Southern Coke No. 4	17 35 to 18 35
Southern No. 1 soft	18 85 to 19 85
Southern No. 2 soft	18 35 to 19 35
Southern Gray Forge	17 60 to 18 10
Southern Silveries (4% to 5% silicon)	20 60 to 21 10
Southern Silveries (5% to 6% silicon)	20 85 to 21 35
Jackson Co. Silveries (6% to 8% silicon)	23 30 to 24 30
Jackson Co. Silveries (8% to 10% silicon)	24 30 to 25 30
Ohio Strong Softeners	21 50 to 22 00
Alabama and Georgia Car Wheel	26 35 to 27 35
Malleable Bessemer	19 50 to 20 00
Basic Iron	19 85 to 20 35

Bars.—The bar situation is not especially flattering to the producers in point of activity. Steel bars are holding firm but there are some further concessions in iron bars and the usual range of quotations during the past week has been from 1.67½c to 1.72½c, according to specifications, steel holding to 1.76½c. One lot of over 1,000 tons of iron has been sold and a few for fairly good tonnages below that amount but in general the users of bars are waiting. There are all kinds of evidence that buying will be heavier soon and already the specifications are gaining slowly week by week. From store the price of iron bars continues at a $2 premium over steel, but sooner or later there will be an adjustment. We quote mill shipments, Chicago delivery, Bessemer steel, 1.76½c; angles, less than 3x3, 1.86½c base; hoops in lots of 250 tons and greater, 2.06½c; less than this amount, 2.16½c; iron, 1.70c to 1.75c. Quotations from store, steel, 2c; iron, 2.10c; hoops, 2.40c to 2.50c; angles, 2.25c rates.

Sheets.—The situation in sheets is a healthy one from the producing standpoint. The mills are generally well supplied with orders and production is large. Store trade is steady. We quote mill shipments, carload lots, Chicago delivery, as follows: No. 27 black, 2.86½c to 2.91½c; No. 28, black, 2.96½c to 3.01½c. Galvanized 75 and 5 percent. On lots from store, we quote No. 27 black, 3c to 3.05c; No. 28 black, 3.10c to 3.15c. Galvanized, 75 percent to 75 and 2½ percent.

Structural Steel.—Careful surveyors of the market for structural steel say there is a perceptible improvement in the buying of the past week. No large contracts are reported but the gains come in the number and frequency of the small orders. There is no decided activity but the tendency is in that direction. Store trade is also improving and prompt shipments can be made. We quote mill prices, Chicago delivery: Beams and channels, 16 inches and under, 1.75c; 18 inches and over, 1.85c; universal plates, 1.75c; angles, 3x3 and larger, 1.75c; tees, 3x3 and larger, 1.80c; zees, 1.75c. Lots from store, 2¼c per pound.

Plates.—Little new business of a noteworthy character has occurred but the tone of the market is strong, with deliveries from mill backward rather than easy. We quote mill prices, Chicago delivery, as follows: Tank steel, ¼ inch and heavier, 1.75c; flange steel, 1.85c. Prices for lots from stock: Tank steel, ¼ inch and heavier, 2.15c to 2.25c; 3-16, 2.25c to 2.35c; No. 8, 2.30c to 2.40c; No. 10, 2.35c to 2.45c; flange steel, 2.40c to 2.50c.

Rails and Track Supplies.—Trading in steel rails in the West, either for 1903 or 1904 deliveries, has been quiet this past week. There are a number of deals pending but the quiet of mid-summer has operated against activity. We quote standard sections, 500 tons and over, $28; less than 500 tons to carload lots, $30; less than carload lots, $32; second quality rails, $27; light rails, 45 pounds, $34 to $35; 12 pounds, $39 to $40; regular differentials for intermediate sizes. Track supplies, mill shipments: Angle bars, 2c to 2.10c; spikes, first quality, 2.25c (out of store, carload lots, 2.35c to 2.45c rates); second quality, 2.10c; track bolts, 3½x¾, with square nuts. 2.85c to 3c per 100 pounds; with hexagon nuts, 3.05c to 3.15c, with usual differentials for other sizes.

Merchant Steel.—Activity in the placing of merchant steel for the ensuing year is increasing slowly. A few contracts ranging downward from 400 tons have been made. The buying however is moderate, considering the time of year, not because of a decreased consumption, but through the influence of the general backwardness in buying. Prices are unchanged. We quote mill shipments, Chicago delivery, as follows: Spring steel, 2.65c to 2.75c; sleigh shoe, 1.95c flat sizes; concave and convex, 2c; out of store, 2.15; cutter shoe, 2.50c to 2.60c; machinery steel, 2.15c to 2.25c base; plow steel, 2.50c and upwards, according to quality; toe calk, 2.30c to 2.40c; out of stock, 3c to 3.10c; ordinary tool steel, 6c to 7c; specials, 13c and upwards; less than carload lots, 5 and 10 percent higher;

cold rolled shafting, carload lots, 47 percent off; less than carload lots, 42 percent off.

Merchant Pipe.—Mills are sold up for the balance of the year on the larger sizes. Mains that were formerly eight inches in diameter are now running up to fourteen inches, and the demand for the latter is perhaps relatively larger than formerly. There have been serious inroads made upon stocks and the trade generally is flourishing. We quote carload lots mill shipments, random lengths, f. o. b. Chicago, as follows:

	Steel Pipe.		Guaranteed Wrought Iron Pipe.	
	Black. Percent.	Galv. Percent.	Black. Percent.	Galv. Percent.
⅛ to ¾ in. inclusive	66.35	56.35	63.35	53.35
½ inch	68.35	58.35	65.35	55.35
¾ to 6 inches	73.35	63.35	71.85	61.85
7 to 12 inches, inclusive	67.35	57.35	64.35	54.35

Less than carload lots, 12½ percent advance over above prices.

Boiler Tubes.—The steady call for this product, which runs through the entire year, usually shows little if any variation. Stores say however that the call during the last half of June showed gains over the first half. There are reports also from builders of engines, which denote an increasing activity in the construction of power. Prices are without change. Our quotations below are on carload lots, mill shipments, f. o. b. Chicago. On less than carload lots, 12½ percent is to be added:

	L. W. Steel Percent.	C. C. Iron Percent.
1 to 1½ in.	43.35	38.35
1¾ to 2½ in.	55.85	35.85
2¾ to 5 in.	60.85	45.85
6 to 13 in.	55.85	35.85

For lots direct from warehouse stock:

	L. W. Steel Percent.	C. C. Iron Percent.
1 to 1½ in.	40	35
1¾ to 2½ in.	50	32½
2¾ to 5 in.	57½	42½
6 to 13 in.	50	32½

Cast Iron Pipe.—No especially noteworthy transactions in cast pipe are reported but there have been an increased number of small purchases, making the aggregate trade somewhat better. In large tonnages figures are slightly better but small lots are unchanged. We quote on carload lots, f. o. b. Chicago, 4-inch water pipe, $33; 6-inch, $32; 8-inch and upwards, $31; gas pipe, $1 a ton higher.

Billets and Wire Rods.—The market has been uneventful with prices as formerly. We quote German basic Bessemer billets, $28.50 to $29, seaboard; domestic Bessemer billets, $32.80; open-hearth billets for rolling mill use, $30.50 to $31; for forging purposes, $34 to $36; wire rods, $39.50 to $40.

Wire and Wire Nails.—Going more largely than most other metal products directly to the farmer, wire and nails are more the creature of crop conditions. Therefore the improvement in the latter is beneficial. The tone of the market is better, as viewed from a comprehensive position. There are excellent symptoms of a brisk fall trade in both wire and nails. Bale ties have advanced five percent on account of the heavy demand, the hay crop being unusually promising for the season. Quotations to jobbers, Chicago delivery, are as follows: Wire nails, carload lots, $2.20; less than carload lots, $2.30. Cut nails, steel, carload lots, $2.26½; less than carload lots, $2.36½. Plain wire, $2.10 carloads, and $2.20 in smaller lots; galvanized, carloads, $2.40; smaller lots, $2.50. Barbed wire, carloads, $2.50; less than carloads, $2.60; galvanized carloads, $2.80; less than carloads, $2.90; staples, carloads, $2.30; smaller lots, $2.40; galvanized, car loads, $2.60; smaller lots, $2.70. Bale ties, 80 and 20 percent discount f. o. b. Waukegan on straight carload lots. Poultry netting, 85 and 5 percent discount from list f. o. b. Joliet or DeKalb, with actual freight allowed not exceeding 50 cents per 100 pounds.

Coke.—If there is any difference it is in the direction of lower prices. The one conspicuous feature of the market is the low price of spot coke as compared with contract, the difference amounting to a dollar or more. This condition is operating against the renewing of contracts and in favor of large purchases for storing. Regularly Connellsville foundry is quoted from $3.25 to $3.75, and New River, $2.50 to $3.

Old Material.—Prices continue to recede and offerings are the more conspicuous. Occasionally a buyer or a consumer wants some scrap, and when he makes his inquiry he is likely to pay fifty cents or a dollar over the price, at which the transaction would have been closed had the overtures begun at the other end. Hence there is considerable irregularity in quotations with prices slowly declining. Dealers' selling prices in gross tons follow:

Old iron rails	$20 50 to 21 00
Old steel rails (mixed lengths)	16 50 to 17 00
Old steel rails (long lengths)	19 00 to 20 00
Relaying rails	29 50 to 30 00
Old wheels	19 50 to 20 00
Heavy melting steel	15 50 to 16 50
Mixed country steel	12 50 to 13 50

The following are selling prices per net ton:

No. 1 R. R. wrought	$1500 to 16 00
No. 2 R. R. wrought	14 00 to 15 00
Shafting	15 50 to 16 50
Dealers' forge No. 1	12 50 to 13 50
No. 1 busheling and wrought pipe	12 00 to 12 50
No. 1 cast	14 00 to 15 00
Heavy cast (300 pounds and over)	10 00 to 10 50
Country malleable	12 50 to 13 00
Iron axles	19 50 to 20 50
Steel axles	17 00 to 17 50
Cast borings	5 50 to 6 00
Mixed borings, etc.	5 50 to 6 00
Wrought turnings	12 00 to 12 50
Machine shop turnings	12 00 to 12 50
Iron axle turnings	12 50 to 13 00
Steel axle turnings	12 00 to 12 50
Stove plate and light cast scrap	9 00 to 9 50
Old iron splice bars	16 00 to 17 00

CLEVELAND.

OFFICE OF *The Iron Trade Review*,
1064 ROSE BUILDING, July 8.

The shipments of ore for June were somewhat smaller than for the same month last year, the ports showing a decrease being Gladstone, Marquette, Escanaba and Ashland. The shipments were as follows:

	1903.	1902.
Escanaba	666,805	686,199
Gladstone	3,091	14,701
Marquette	311,433	370,316
Ashland	436,510	530,749
Superior	607,574	552,455
Duluth	829,950	801,013
Two Harbors	863,990	796,263
	3,719,353	3,751,691

The loss in June, 1903, is 32,343 tons, but Ashland and Two Harbors made very large increases. There is now a congestion of vessels at both upper and lower lake ports, the fact that no work was done Saturday and Sunday being responsible to a large extent for this condition. Unloading of coal at upper ports has proceeded so slowly that some vessels have been compelled to wait ten days before starting on their return trips. Very little ore is being sold and there is no prospect that the demand will improve. If it does not, a marked decrease in shipments may be expected. Rates on wild cargoes are firm and unchanged.

Pig Iron.—As many foundries are closed to take inventories, little interest is shown in the market. Inquiries are few and almost no sales are being made. Some foundrymen confess that they will need iron very soon, but say they will put off buying to the last moment and then buy in limited quantities. Sales of Southern iron continue on at from $14 to $14.50 for No. 2. The strike of coal miners has not yet had appreciable effect and will not have unless it lasts five or six weeks. One furnace making basic found it had a small surplus and offered it, but obtained no response. We continue to quote, f. o. b. Cleveland, with the exception of gray forge, which is quoted at Valley furnace:

Bessemer	$19 35 to 19 85
No. 1 Strong Foundry	19 35 to 19 85
No. 2 Strong Foundry	18 60 to 19 10
No. 3 Foundry	18 35 to 18 60
Scotch No. 1	19 35 to 19 85
Scotch No. 2	18 60 to 19 10
Gray Forge, Valley furnace	18 00 to 18 25
Lake Superior charcoal	23 00 to 24 00

Finished Material.—Specifications are coming in satisfactorily and at some mills in amount equal to that of last year. Notice that a contract for about 1,300 tons of

structural material was about to be awarded has been the interesting event in that line. Bar mills are now closed, some for two weeks and others for a month. Bar iron is selling at 1.70c, Cleveland, at local mills and at 1.70c to 1.80c, Youngstown, by the largest producers, and a fair tonnage has been disposed of. Prices for steel bars, 1.60c Pittsburg for Bessemer and 1.70c for open-hearth, have been reaffirmed. The market is quiet. Jobbers in sheets report business in fair condition. The prices of the principal producer through jobbers continue as follows: Galvanized sheets, mill sales, carload lots, Nos. 10 and 11, 2.60c; Nos. 12-14, 2.70c; Nos. 18 to 21, 3c; Nos. 22 to 24, 3.20c; Nos. 25 and 26, 3.55c; No. 27, 3.80c; No. 28, 4.05c; No. 29, 4.45c; No. 30, 4.95c. Galvanized sheets out of stock are quoted 75 and 5 off. For 3-16-inch black sheets and heavier we quote 2.15c, Cleveland. Mill sales of black sheets to consumers are made on the following basis: No. 24, 2.65c to 2.75c; No. 26, 2.75c to 2.85c; No. 27, 2.85c to 2.95c. The following are prices out of stock: No. 10, 2.35c to 2.50c; No. 12, 2.45c to 2.60c; No. 14, 2.50 to 2.60c; No. 16, 2.60c to 2.70c; Nos. 18-20, 2.75c to 2.85c; Nos. 22-24, 2.85c to 2.95c; Nos. 25-26, 2.95c to 3.05c; No. 27, 3.05c to 3.15c; No. 28, 3.15c to 3.25c.

Old Material.—There is more inquiry, but business has not improved, and prices are settling to a lower basis. We have revised quotations as follows, f. o. b. Cleveland, all gross tons:

Old iron rails	$21 50 to 22 00
Old steel rails (over 6 feet)	20 00 to 20 50
Old steel rails (6 feet and under)	17 50 to 18 00
Old car wheels	19 50 to 20 00
No. 1 R. R. wrought	15 00 to 16 00
Mill scrap	16 00 to 17 00
No. 1 machine cast scrap	15 00 to 16 00
Iron axles	24 00 to 25 00
Steel axles	25 00 to 26 00
Axle turnings	15 00 to 16 00
Wrought turnings (free from cast)	14 00 to 15 00
Cast borings	9 00 to 9 50
Uncut wrought iron boilers	11 00 to 12 00
Steel boiler plates	14 00 to 15 00
Grate bars	12 00 to 13 00
Pipes and flues (clean)	16 00 to 17 00
Tank iron	16 00 to 17 00
Hoop and band iron	12 00 to 12 50
Sheet iron	11 00 to 12 00
Wrought drillings	14 00 to 15 00
Malleable iron (railroad)	18 50 to 19 00
Malleable iron (agricultural)	15 00 to 15 50
Stove plate	11 00 to 12 00
Heavy steel	18 00 to 18 50

CINCINNATI.

July 7.

The coke market is quiet and irregular. There seems to be a disposition among the ovens in the Connellsville district to hold firm views but Virginia cokes are reported as easy. Furnace coke is quoted from $2.25 f. o. b. ovens up to $3.25 and foundry coke from $3.25 up to $4 f. o. b. ovens. The ruling quotation for foundry coke is $3.50 at the ovens.

Pig Iron.—The only buying of importance the past week in this territory was done by a large pipe maker. In all about 6,000 tons were taken of various grades ranging from No. 3 foundry down. Prices were irregular and most of the iron taken was bargain lots. The No. 3 foundry was said to have gone at $13 to $13.50; No. 4, $12.50 to $13; gray forge, $11.25 to $11.50, all f. o. b. Birmingham. Some mottled iron is reported sold at $11.75 Birmingham. Aside from this business the holiday was hardly noticed in the duliness which prevailed. The prospective order of a large consumer in Chicago has developed nothing except a purchase of some malleable iron. The low quotations brought out on this prospective business have to a large extent been withdrawn and are not fairly representative of current prices. The trend of the market is, however, still downward and for No. 2 foundry $13.25 Birmingham has been done with $13.50 more easily accepted on any attractive business offering. The association furnaces are still adhering to their schedule and while there has been considerable talk of another meeting it is generally believed now that no meeting will be held until something more definite is known as to the prospects of a prolonged strike of the coal miners in the Birmingham district. There is now no large business in sight to test the market for low prices, and on the small carload orders coming in, quotations range from $13.50 to $14 Birmingham. It has become almost a settled conviction, in the minds of sales agents, that melters will not cover for the second half of the year, but will buy for current needs or to cover ninety days' requirements at the outside. In regard to Ohio furnaces the week has developed nothing new and in Southern Ohio $16.50 furnace for No. 2 foundry is still the inside quotation. We quote the market for delivery f. o. b. Cincinnati:

Southern Foundry No. 1	$17 00 to 17 50
Southern Foundry No. 2	16 50 to 17 00
Southern Foundry No. 3	16 25 to 16 50
Southern Foundry No. 4	15 75 to 16 25
Southern Foundry No. 1 soft	17 00 to 17 50
Southern Foundry No. 2 soft	16 50 to 17 00
Gray Forge	14 50 to 15 00
Northern Foundry No. 1	18 15 to 18 65
Northern Foundry No. 2	17 65 to 18 00
Southern car wheel iron	26 25 to 27 25

A rumor has been current in pig iron circles for the past ten days, that large independent furnace interests were arranging to promulgate a schedule on a $12 Birmingham basis for No. 2 foundry, which was to be done in order to anticipate a rumored proposed action of the association furnaces. This coup was supposed to be planned to take effect July 1. As a matter of fact the whole story seems to have originated as a joke, but it has been taken quite seriously. The atmosphere seems charged with the $12 price rumor, but nothing tangible is obtainable. Those who ought to know positively assert that there is nothing in the story so far as the independent furnace interests are concerned and the association furnaces deny that there is any understanding on their part to make a $12 price or any other figure at variance with the schedule now in effect.

Finished Material.—The market shows but little change. The demand is fairly active in a jobbing way with large buyers holding off. The volume of business in small orders is good. The jobbing demand for structural shapes is active and structural yards are busy. In bar iron $1.70 base can be done on any large business offering but the ruling quotation is $1.73 base the same as for steel. Iron bar, car lots, are quoted at $1.73 to $1.75 base, half extras. Steel bars remain at 1.73c base, half extras, with the retail price 2c base, half extras, for both out of store. Galvanized sheets are being quoted at 75 and 5 percent off. We quote black sheets No. 27 at 2.78c in car lots of 500 bundles. Black sheets out of store are selling as follows: No. 28, 3.10c; No. 27, 3.20c; No. 16, 2.65c; No. 14, 2.55c; No. 12, 2.45c; No. 10, 2.35c. Tank plates are firm and sell out of store at 2.15c for ¼-inch and 2.25c for 3-16-inch. Beams and channels are quoted at 2.15c to 2.25c from stock, and angles at 2.15c to 2.25c for base sizes. The merchant pipe market holds steady and unchanged with a firm tone prevailing. We quote:

MERCHANT PIPE.

(Basing Discounts.)

	Steel Pipe. Black. Percent.	Steel Pipe. Galv. Percent.	Guaranteed Wrought Iron Pipe. Black. Percent.	Guaranteed Wrought Iron Pipe. Galv. Percent.
⅛, ¼, ⅜ inch	66.7	56.7	63.7	53.7
½ inch	68.7	58.7	65.7	55.7
¾ to 6 inch, inclusive	73.7	63.7	70.7	60.7
7 to 12 inch, inclusive	67.7	57.7	64.7	54.7

BOILER TUBES.

	Steel Percent.	Iron Percent.
1 to 1½ inch	41.2	35.2
1¾ to 2½ inch	54.2	34.2
2¾ to 5 inch	59.7	44.2
6 to 13 inch	54.2	34.2

Old Material.—The market continues dull with dealers timid about making purchases and melters holding off in their buying. The waiting condition of the pig iron market is reflected in the scrap trade. We quote:

Old No. 1 railroad wrought, net tons	$15 00 to 16 00
Cast machine and foundry, net tons	12 00 to 13 00
Old iron rails, gross tons	21 00 to 22 00
Old steel rails, gross tons	18 00 to 19 00
Old short lengths, gross tons	15 00 to 16 00
Old iron axles, net tons	22 00 to 23 00
Stove plate, net tons	10 00 to 11 00
Wrought turnings, net tons	13 00 to 14 00
Cast borings, net tons	7 50 to 8 50

PHILADELPHIA.

July 7.

Owing to no business being done last Saturday and to the closing of many plants for stock-taking, repairs, etc., the market has been very quiet. The little business transacted is in small lots. The outlook is not, however, unfavorable and it is believed that business will soon improve.

Pig Iron.—Buying continues in small orders. There is apparent diminution in consumption. Foundrymen report prospects are encouraging. Prices are unchanged at $18.50 to $19 for No. 2 X foundry, and $18 to $18.25 for gray forge. Neither buyer nor seller is willing to commit himself beyond the next thirty days.

Finished Material.—There is a general suspension of work at the mills and time of resumption depends to some extent on how promptly orders are received. Prices are weak, about as follows: Plates—Small lots, 1.90c to 1.95c; carload lots, ¼-inch and thicker, 1.75c to 1.80c; universals, 1.80c; flange, 2c; marine, 2.10c to 2.15c; firebox, 2.20c to 2.25. Bars—Prices for carloads are usually quoted at from 1.75c to 1.80c for refined iron and 1.70c to 1.75c for steel bars. Structural Materials—Beams, angle and channels, ordinary sizes, 1.73½c to 1.80c for carload lots with the usual addition for smaller quantities.

Old Material.—There is practically nothing being done and prices are nominal. We quote: Old steel rails, $20 to $20.50; miscellaneous heavy steel scrap, $19.50 to $20; low phosphorus scrap, $26 to $27.50; old steel axles, $22 to $23; old iron axles, nominal, $25 to $27; old iron rails, nominal, $22 to $23; old car wheels, nominal, $22 to $22.50; choice scrap, railroad No. 1 wrought, $19.50 to $21; country scrap, $18 to $19; machinery cast, $17 to $18; No. 2 light scrap (forge), $17.50 to $18.50; No. 2 light scrap (ordinary), $13 to $14; wrought turnings, $14 to $14.50; wrought turnings, choice heavy, $15 to $15.50; cast borings, $9.50 to $10; stove plate, $13 to $14.

NEW YORK.

OFFICE OF *The Iron Trade Review*,
ROOM 1909, NO. 150 NASSAU ST., July 7.

Pig Iron.—It was thought that the opening week of the present month would usher in a buying movement of some proportions, but it has not yet materialized, although all reports represent consumers' stocks as being in a much depleted condition. The meeting point between buyers and sellers is thought to be near. In view of the report, though unconfirmed, that another meeting of the associated Southern furnaces will soon be called, buyers are banking on a lower schedule of prices being promulgated. The announcement that a large Western inquiry is pending, with current reports indicating that a sale will be made at lower prices than those now ruling, has strengthened buyers in the belief that it will be to their interest to defer placing orders, until a definite outcome of this matter is made known. Furnace companies on the other hand say they can afford to wait for buyers, one leading Southern interest declaring that orders now on its books cannot be filled before October. No interest whatever is manifested in foreign iron, and new foreign business seems to be a thing of the past. New York prices for nearby delivery are, nominally, as follows: Northern No. 1 X, $19.25 to $19.75; No. 2 X, $18.25 to $18.75; No. 2 plain, $17.50 to $18; Southern No. 1 foundry, $18.75 to $19.25; No. 2 foundry, $18.25 to $18.75; No. 3 foundry, $17.75 to $18.25; No. 4 foundry, $17.25 to $17.75.

Rails.—Inquiries for 1904 are numerous, and orders recently placed have represented a good tonnage. The activity and the inquiry are better than has been witnessed on the opening of the books for a new year in some time.

Billets.—New business in German basic billets is slow, and contracts are closed only after considerable delay. The tonnage is small. Prices are around $27.50 for this delivery, duty paid.

Finished Iron and Steel.—The feature of the finished material market is the eagerness displayed by some makers of structural shapes in going after orders. One must go back several years to discover anything like it. Labor troubles still operate as an adverse factor, although the disturbances which have been on in the building trades in this city for the past two months, are in process of settlement. Agreements have recently been reached on many of the main contentions.

The American Bridge Co. had a week of small orders but these aggregated a good tonnage. For sheets there is a fair demand, with prices unchanged. Plates are steady, with prompt deliveries more generally made. Bars are quiet, with quotations somewhat irregular. New York prices are as follows: Beams and channels, 15 inches and under, 1.75c to 1.90c; angles, 3 to 6 inches, 1.75c to 1.90c; zees, 1.75c to 1.90c; bulb angles, 2.05c to 2.35c; deck beams, 2.05c to 2.25c; sheared steel plates, tank, 2.10c to 2.15c; flange, 2.25c to 2.30c; firebox, 2.30c to 2.50c; refined iron bars, 1.85c to 2c; soft steel bars, 1.75c to 1.85c; steel sheets, in carloads, New York, No. 28, black, 2.90c to 3.05c; galvanized 75 and 2½ off.

BIRMINGHAM, ALA.

July 7.

There are no new developments in the situation in this district. The union coal miners are still out, no agreement having been reached. In fact, nothing has been done the past week looking to adjustment of a new scale, as the miners were arranging to take a holiday anyway for a week or so, including the usual celebration of the Fourth. It is generally thought that some agreement will be arrived at this week or next and a call issued for the joint convention of operators and miners to meet and agree on details. The operators give it out that they have nothing else to offer than the proposition already rejected and the miners say they will not accept this. A prolonged shutdown may change the views of one or both sides.

So far there has been but little reduction in the output of iron as a result of the suspension of coal mining. The Lacey-Buek Iron Co. has blown out its furnace at Trussville with a view of making extensive repairs, choosing the present as an opportune time for such work. Both the Woodstock furnaces have been out for some time. If no coke is made in the next week or ten days, other stacks here and there will be banked. The larger companies have accumulated six weeks' fuel supply on an average, though some of their stacks will be put out of commission at this time for general overhauling. About 11,000 men are idle as a result of the shutdown, most of these, of course, being miners and day-men at the mines. The different railroads have annulled a number of coal trains, as there is hardly one-fifth the usual output of coal being produced.

The Metal Market.

NEW YORK.

OFFICE OF *The Iron Trade Review*,
ROOM 1909, NO. 150 NASSAU ST., July 7.

Pig Tin.—Dullness of the most pronounced type was noted in the market during the past week. Current orders were of the most meager kind. Lower prices have been the rule for the week, and declines of about ½ cent in spot and futures have taken place. The London market has been inactive, and spot has receded over £1 since our last report. The closing prices at the Metal Exchange today were as follows: Spot to July, $27.50 to $27.75; August, $27.50 to $27.70. London closed today as follows: Spot, £126; futures, £123. Arrivals for the month to date amount to 1,005 tons, against 2,210 tons for the same time last year.

Copper.—As foreshadowed last week, "official" prices were reduced on Friday, amounting to one-half of a cent in Lake, electrolytic, and casting. Although the new prices make Lake and electrolytic 14c, offerings are being made in the open market at less, some being willing to close contracts in these grades at 13½ cents for the remainder of the year. In casting even more liberal concessions from "official" prices are offered. Trade is extremely quiet, and buyers are holding off for lower prices, with the prospects bright for getting them. The London market has been very weak, and declines of over £1 took

place. The closing prices at the Metal Exchange today were as follows: Lake and electrolytic, 14c; casting, 13½c to 13¾c. London closed today as follows: Spot, £56 12s 6d; futures, £56 5s. Exports up to July 3 amounted to 216 tons, against 1,231 tons for the same period last year.

Lead.—Still selling at 4.12½c in carload lots. St. Louis is 3.97½c, and London £11 8s 9d.

Spelter.—Has declined to 5⅞ to 6c for spot. St. Louis is slightly stronger at 5.60c. London is a little higher at £20 15s.

Antimony.—Cookson's is 7½c; Hallet's is 6⅝c, and other brands are 6⅜c.

Quicksilver.—Still quoted at $47.50 per flask of 76½ pounds in lots of 100 flasks. London unchanged at £8 2s 6d.

Nickel.—Is selling at 40c to 47c for large lots down to a ton, and 50c to 60c for smaller quantities.

CHICAGO.

OFFICE OF *The Iron Trade Review*,
1115 MONADNOCK BLOCK, July 7.

There has been little life to the metal markets during the past week. They are considerably weaker and in some instances dealers have been forced on that account to throw products that are comparably salable on the market. Quotations are as follows: Lake copper, carload lots, Chicago delivery, 14⅛c to 14¼c; smaller quantities, 14⅝ to 14¾c. Pig tin, 29¾c; pig lead, 4.30c in 50 to 100-ton lots, and 5¾c to 6c in lesser quantities; spelter, 5½c in carload lots, and 5¾c to 6c in lesser quantities; sheet zinc, 6¾c; antimony, 10¾c to 11c for Cookson's, and 9¾c for Hallett's. We quote old metals as follows: Copper wire, 11⅞c; heavy copper, 11⅞c; light copper, 11c; heavy red brass, 12c; light brass, 10⅝c; red turnings, 9½c; yellow turnings, 11½c.

Pickands-Magee Coke Co.

The Pickands-Magee Coke Co. has just established headquarters at 1210-11 Frick Building, Pittsburg. The company was recently chartered in Pennsylvania with $100,000 capital stock and the privilege of increasing to $500,000. The parties interested are W. C. Magee, formerly vice president of the H. C. Frick Coke Co., and Pickands, Brown & Co., of Chicago. While the officers have not yet been elected, they will be as follows: W. C. Magee, president; C. P. Wheeler, Chicago, of Pickands, Brown & Co., vice president; J. J. Armstrong, Uniontown, Pa., of Pickands, Brown & Co., secretary. The Pickands-Magee Coke Co. does not propose to manufacture any coke, but will devote its attention to handling the product of the smaller operators in the Connellsville and adjacent regions, for which a field was left open by the retirement on January 1 last of the H. C. Frick Coke Co. as a handler of any coke outside of its own make. The company has already made arrangements to handle all or part of the product of over a dozen operators, dating from July 1. Of half these it will handle the entire product, the balance having some product sold on contracts which they will carry out themselves.

Inter-State Steel Company.

The Inter-State Steel Co., Pittsburg, recently chartered, and which is controlled by about the same interests controlling the Allegheny Steel & Iron Co., has let some of the contracts for the blued sheet plant to be erected at Avenue, Pa., near the steel works and sheet mill of the Allegheny company. No new mills will be bought at present, as the parties interested have two mills which have been used as cold mills at the Newcomerstown, O., plant, leased from the Tuscora Steel Co. by the Sheet Steel Co., an allied interest. The lease on this plant will be given up next September and the cold mills removed to Avenue. Later the Inter-State Steel Co. may go into the manufacture of Russia iron. The blued sheets to be made at once will be marketed under the brand "Velvet Blue."

UNITED STATES STEEL CORPORATION EARNINGS.

The directors of the United States Steel Corporation met in New York July 7 and declared the regular quarterly dividends of 1 percent on common stock and 1¾ percent on preferred stock. They also issued a statement showing the net earnings for the quarter ended June 30 to be $36,499,528 as compared with $37,662,058 for the same period last year, a decrease of $1,162,530. Net earnings for the half-year aggregate $61,568,235, as against $64,377,515 last year. Deducting amounts set aside for sinking funds on bonds, depreciation and reserve funds reduces the net earnings for the six months of this year to $54,182,936. After payments of dividends and interest on bonds there is an undivided profit or surplus for the six months of $17,037,047. The company has unfilled orders on hand amounting to 4,666,578 tons. Last year this time these orders aggregated 4,741,993 tons. With the $17,037,047 additional added to surplus in the past six months the total surplus July 1 is $94,911,644.

New York Foundrymen Organize.

Owners of foundries in New York and vicinity formed an organization on June 30 to be known as the New York and New Jersey Foundrymen's Association. H. Van Atta was elected president. Many of the 200 foundries in the New York district are already members of the National Foundrymen's Association. The new organization will work with it, though not directly affiliated, and will deal with local conditions after the manner of the New York Metal Trades Association. The following officers were elected: President, H. Van Atta, of the J. L. Mott Iron Works; vice president, Lawrence Fagan, of the Fagan Iron Works; treasurer, Francis J. Jackson, of the Hecla Iron Works, and secretary, Henry C. Hunter, who is commissioner of the New York Metal Trades Association. The executive committee consists of the officers and T. Schriever, of Schriever & Co., and J. F. Arnold, of Snead & Co. Already the new association has business on hand. The coremakers have made a demand for a uniform rate of $2.75 and a committee from the local foundrymen's association has been appointed to confer with a committee of the Iron Molders' Union on the subject.

Negotiations are pending between the Consolidated Lake Superior Co. and the banking firm of Speyer & Co., New York, in regard to the renewal of the $5,200,000 loan made by the bankers to the company. The negotiations involve the further question whether the bankers shall advance the company additional working capital to the amount of $2,000,000, which, it is declared by persons in authority, the company needs to develop its earning power effectively. The loan of $5,200,000 fell due July 1 and has not been paid. The banking firm has not yet signified what it will do.

U. S. Consul W. W. Canada reports from Veracruz, June 8, 1903: "The Mexican Government has reduced the import duty on ferro-manganese with the view of encouraging the manufacture of steel by modern methods in the republic. Ferro-manganese containing 25 percent or more of manganese was formerly subject to a customs duty of $5 per 100 kilograms (5 cents silver, or about 2.25 cents gold, per 2.2 pounds) gross weight; the new rate of duty has been fixed at $1.50 per 100 kilograms (1.5 cents silver, or 0.67 cent gold, per 2.2 pounds) gross weight."

The Bureau of Navigation reports that in the fiscal year ended June 30, 1903, 1,535 vessels, of 456,076 gross tons, were built in the United States and officially numbered, compared with 1,657 vessels, of 473,981 gross tons, for the previous fiscal year. Returns of vessels under construction on July 1, 1903, in the United States indicate for the new fiscal year an output below that of the year just ended.

The Allis-Chalmers Co. has issued an order at Milwaukee that men in its employ shall not be allowed to take beer upon the premises of the company.

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JULY 9, 1903

HOW THE STEEL CORPORATION'S BONUS PLAN WORKS.

The practical operation of the plan of the U. S. Steel Corporation in selling stock to employes is illustrated by the settlements recently made in the cases of a number of employes who have died. Life insurance, as well as a profitable investment, is afforded. The following is a statement of one of the cases:

Peter Collins, deceased, formerly in the employ of the Illinois Steel Co., subscribed to and was awarded four shares of the preferred stock of the United States Steel Corporation at $82.50. The deceased had made partial payments on his subscription, amounting to $40, and under date of June 6, the United States Steel Corporation paid to Margaret and Ellen Collins, heirs of Peter Collins, the sum of $149.06, as follows:

Amount paid on subscription	$40.00	
Dividends credited	14.00	
	$54.00	
Less for interest at 5 percent on deferred payments	4.94	
	$49.06	
Special bonus of $5.00 per share per year for five years which deceased would have received had he lived and remained continuously in the employ of the company..	$100.00—	$149.06

Had Peter Collins lived and remained in the employ of the company, he would have received as of January 1, 1904, a special bonus of $5.00 per share upon his subscription. This would have reduced the price of the stock to him to $77.50 per share. Each year, for five years, this would have been repeated, so that at the end of the five years, his stock would have cost him $57.50 per share, and he would have received in addition dividends at the rate of 7 percent per annum on the part value of his stock, or $28.00 per annum, less, of course, the interest at 5 percent on deferred payments. This figures an average return for the first five years of about 10 percent on his investment. At the end of five years, he would therefore have four shares of stock costing him $57.50 per share, or $230, on which he would receive thereafter $28 per annum, or 12.17 percent on his investment.

Thus far fifteen employes, subscribers to the preferred stock under the above plan, have died, and the United States Steel Corporation has settled with their heirs or estates on the same basis as the above illustration. The deceased employes worked at the following plants:

Carnegie Steel Co., two at the Homestead Works and one at the general office; Illinois Steel Co., one at the Joilet Works, and one at the Union Works; American Sheet Steel Co., one each at the McKeesport Works and Aetna Works, and one at the general office; American Tin Plate Co., one at the American Works, and one at the New Castle Works; American Steel & Wire Co., one at the Consolidated Works; American Bridge Co., one each at the Pencoyd Works and Albany Works; National Tube Co., one at the National Department; H. C. Frick Coke Co., one at the Adelaide Works.

National Wire Corporation Galvanized Wires.

The National Wire Corporation, of New Haven, Conn., has issued a special price list of galvanized telegraph and telephone wire and wire strand, effective July 1. The three standard grades of telegraph and telephone wire made by the company are the E. B. B., B. B. and S. B. B. The first is extra double galvanized with the best grade of pure zinc and is especially adapted to the severe requirements of railroad, telegraph and telephone companies whose lines are subjected to the corrosive action of soft coal smoke and where low resistance is desired. The B. B. is made from special material, higher in tensile strength, but with slightly higher resistance. It is extra double galvanized wth the best grade of pure zinc. This wire is adapted for telephone service, requiring the best galvanizing, but using smaller sizes of wire, where higher tensile strength is required, to avoid as far as possible the breaking of wires due to ice and other unusually severe strains. The S. B. B. is made from the same material as B. B. grade. It is double galvanized with high grade spelter. It meets the requirements of country telephone companies and street railroad telephone lines where the wire is not exposed to soft coal smoke. The company's galvanized steel wire strand, seven wires coiled into a single strand, is designed for guys, span wires and single strand. The ½-inch strand weighs 52 pounds to 100 feet and has a strength of 10,000 pounds. There are seven sizes between this and the 3-32 inch diameter strand which weighs 2¼ pounds per 100 feet and has a strength of 500 pounds. Copies of the list are sent on application.

Condition of the United States Steel Co.

About two hundred and fifty stockholders of the United States (Jupiter) Steel Co., of Everett, Mass., held a meeting in Boston, July 2, to hear the report of the special committee appointed to investigate the company's condition. There is a floating debt of $190,000, and $53,000 credits outstanding for castings. A plan was adopted for an issue of first mortgage 6 percent ten-year bonds for $150,000 on which, it was announced, the International Trust Co. has agreed to advance $30,000. President Miller argued that unless these bonds were authorized the company was likely to go into receivership. His administration was criticised and he offered to resign. The company was incorporated in West Virginia in 1899, with an authorized capital of $3,000,000, of which $2,000,000 is outstanding. Dividends at 12 percent yearly were paid from 1899 to 1902, but in 1903 the dividend was passed. The company manufacturers "Jupiter" steel from steel scrap by patented processes.

Steel Corporation Will Not Build in Canada.

It was reported in New York Tuesday and telegraphed widely in press dispatches that the United States Steel Corporation had announced its intention to begin work shortly on the new steel plant at Port Colborne, Ont., concerning which there has been much newspaper discussion. In response to an inquiry we are officially advised that the corporation has no such intention. The dispatches stated that the works at Port Colborne were designed to take care of Canadian and European trade. The steel works in the United States have heretofore been able to take care of all such trade when they went after it, and are certainly as well able to do so in the future.

The assets of the Pease Car & Locomotive Works, Chicago, have been sold by the receiver in bankruptcy to Luther H. Baldwin for $45,500.

Delaware Water Gap Meeting of the American Society for Testing Materials.

The sixth annual meeting of the American Society for Testing Materials, held July 1, 2 and 3, at Delaware Water Gap, Pa., marked the high point in the career of this important organization. Though its operations until within a year have not had the publicity given to those of the older engineering societies, its work has been most valuable and its growth, particularly in the past twelve months, has been strong and rapid. The report presented at the Water Gap meeting last week showed a doubling in membership since the Atlantic City meeting, or from 175 to 349 in the year. This is well understood to be due in large part to the energetic work of Secretary Edgar Marburg, professor of engineering in the University of Pennsylvania.

Those in Attendance.

The registration, while it did not include all who attended, showed a total of more than 100 names, including some of the best known representatives of the testing and engineering departments of important steel making concerns and of leading consumers of structural steel. The cast iron interest was also represented by an enthusiastic group of investigators who have done good work toward giving that metal a better place in the engineering world. Among those in attendance were the following:

Chas. B. Dudley, chemist Pennsylvania Railroad, Altoona, Pa.
Edgar Marburg, professor of civil engineering, University of Pennsylvania, Philadelphia.
Robert W. Lesley, Philadelphia.
John McLeod, Carnegie Steel Co., Pittsburg.
Geo. F. Swain, Boston.
W. G. Scott, Racine, Wis.
David Reid, Pawtucket, R. I.
D. A. Kohr, Dayton, O.
C. H. Vannier, Griffin Wheel Co., Chicago.
E. H. Martin, Carnegie Steel Co., Pittsburg.
P. E. Carhart, Illinois Steel Co., Chicago.
W. F. Kiesel, Jr., Altoona, Pa.
Walter Wood, R. D. Wood & Co., Philadelphia.
Joseph Royal, Philadelphia.
C. C. Schneider, vice president American Bridge Co., New York.
Chas. Major, American Bridge Co., New York.
H. E. Diller, Western Electric Co., Chicago.
G. H. Clamer, Philadelphia.
Albert Sauveur, editor *Metallographist*, Cambridge, Mass.
Wm. Campbell, New York.
W. O. Dunbar, Altoona, Pa.
E. Platt Stratton, chief engineer surveyor to the American Bureau of Shipping, New York.
John M. Goodell, *Engineering Record*, New York.
John A. Mathews, Syracuse, N. Y.
James Christie, mechanical engineer American Bridge Co., Pencoyd, Pa.
G. W. Thompson, Brooklyn, N. Y.
J. W. Whitehead, Jr., New York.
Gaetano Lanza, Boston.
J. Madison Porter, Easton.
J. C. Kinkead, Schenectady, N. Y.
W. Purves Taylor, Philadelphia.
Harold M. Dabbs, Philadelphia.
S. S. Voorhees, Washington, D. C.
M. McNaughton, Dixon Crucible Co., Jersey City.
R. D. Carney, Steelton, Pa.
Wm. Kent, Passaic, N. J.
M. K. Hatt, Washington, D. C.
L. W. Page, Washington, D. C.
C. W. Boynton, Wheeling, W. Va.
Francis A. J. Fitzgerald, Niagara Falls, N. Y.
Chas. Whiting Baker, *Engineering News*, New York.
J. L. Van Ormun, St. Louis.
A. H. Sabin, New York.
Albert Ladd Colby, Bethlehem Steel Co., South Bethlehem, Pa.
Jesse J. Shuman, Pittsburg.
Chas. L. Huston, Lukens Iron & Steel Co., Coatesville, Pa.
N. B. Williamson, Philadelphia.
H. G. Gillmour, U. S. Navy.
Robert Job, chemist Philadelphia & Reading Railway, Reading, Pa.
E. W. Lazell, Philadelphia.
H. Taggart, Coatesville, Pa.
A. S. Cushman, Washington, D. C.
Gus C. Henning, New York.
A. N. Johnson, Baltimore, Md.
Samuel T. Wagner, city engineer, Philadelphia.
Geo. S. Webster, Philadelphia.
Paul L. Walfer, Philadelphia.
W. M. Parks, U. S. Navy.
Wm. R. Webster, Philadelphia.
C. Kirchhoff, *Iron Age*, New York.
Geo. E. Thackray, Cambria Steel Co., Johnstown, Pa.
Chas. M. Mills, Philadelphia.
Henry B. Seaman, New York.
Richard Moldenke, secretary American Foundrymen's Association, New York.
G. L. Norris, Lewistown, Pa.
F. H. Clark, Chicago.
A. I. Findley, *The Iron Trade Review*, Cleveland.
H. E. Field, Farrel Foundry & Machine Co., Ansonia, Conn.
M. H. Wickhorst, chemist C. B. & Q. Ry., Aurora, Ill.
E. F. Kenney, Philadelphia.
David S. Creswell, Philadelphia.
Edgar S. Cook, Warwick Iron & Steel Co., Pottstown, Pa.
W. C. Du Comb, Jr., Philadelphia.
Henry H. Quimby, Philadelphia.
A. D. Peace, Harrisburg.
Stanley G. Flagg, Jr., Stanley G. Flagg & Co., Philadelphia.
Clifford Richardson, New York.
Jos. W. Bramwell, Philadelphia.
Chas. S. Gowen, Falkenau-Sinclair Co., Philadelphia.
Mansfield Merriman, chief engineer Croton Aqueduct, New York.
Joseph W. Richards, Bethelehem, Pa.
P. W. Shimer, Easton, Pa.
E. D. Meier, Heine Safety Boiler Co., New York.
Edward M. Hagar, Chicago.

WEDNESDAY'S SESSION.

The meeting opened at the Hotel Kittatinny on Wednesday afternoon, July 1, this being in part a business session, with reports of various committees. That on "Preservative Coatings for Iron and Steel" was presented by the chairman, S. S. Voorhees, of the Supervising Architect's office, Washington, D. C. A report was also presented by the committee on "Magnetic Properties of Iron Steel," J. Walter Esterline, chairman.

Walter Wood, chairman of the committee on Standard Specifications for Cast Iron and Finished Castings, made a progress report, in which he emphasized the necessity of the foundry trade agreeing upon the size and form of test bars and upon such methods of making test bars as should relieve internal strains and most accurately represent the strength of the material in the casting. Mr. Wood's committee has allotted its inquiry among various sub-committees through which various details are being worked out. The sub-committee on formulating standards for testing general castings, Thos. D. West chairman, has submitted its recommendations with sub-divisions of various descriptions of gray iron and chilled iron specialties.

Mr. Wood's report called out an animated discussion of the test bar question, which previously has not obtruded itself upon the deliberations of the society. Mr. Wood, while granting that there were many obstacles in the way of the general adoption of a standard for test bars, was of opinion that a useful purpose would be served by the promulgation of an arbitration bar, to which recourse could be had in the settlement of disputed questions.

The result of the ballot on members of the executive committee for the ensuing two years was announced at this session, showing the election of Albert Ladd Colby, of South Bethlehem, Pa., and John McLeod, of Pittsburg.

President's Address.

At the Wednesday evening meeting the president, Dr. Chas. B. Dudley, made the annual address, taking for his subject, "The Making of Specifications." At the outset the president raised the question whether a society organized for investigations in the testing of materials should have to do with the making of specifications; whether its legitimate field was not rather methods of testing and finding out the various properties of materials. He pointed out that in this country the broader view of the work of such a society obtained, rather than the view of the leaders of the International Association, which was that the work of making specifications be undertaken by the engineers or the parties interested. The paper then presented at length the methods followed at Altoona, in connection with the laboratory of the Pennsylvania Railroad

in making specifications. General deductions from the practice of years at Altoona were given in the latter portion of the paper as follows:

1. A specification for material should contain the fewest possible restrictions, consistent with obtaining the material desired.

2. The service which the material is to perform, in connection with reasonably feasible possibilities in its manufacture, should determine the limitations of a specification.

3. All parties whose interests are affected by a specification should have a voice in its preparation.

4. The one who finally puts the wording of the specification into shape, should avoid making it a place to show how much he knows, as well as a mental attitude of favor or antagonism to any of the parties affected by it.

5. Excessively severe limitations in a specification are suicidal. They lead to constant demands for concessions, which must be made if work is to be kept going, or to more or less successful efforts at evasion. Better a few moderate requirements rigidly enforced, than a mass of excessive limitations, which are difficult of enforcement, and which lead to constant friction and sometimes to deception.

6. There is no real reason why a specification should not contain limitations derived from any source of knowledge. If the limitations shown by physical test are sufficient to define the necessary qualities of the material, and this test is simplest and easiest made, the specification may reasonably be confined to this. If a chemical analysis or a microscopic examination, or a statement of the method of manufacture, or information from all four or even other sources, are found useful or valuable in defining limitations, or in deciding upon the quality of material furnished, there is no legitimate reason why such information should not appear in the specifications. Neither the producer nor the consumer has a right to arrogate to himself the exclusive right to use information from any source.

7. Proprietary articles and commercial products made by processes under the control of the manufacturer cannot from the nature of the case be made the subject of specifications. The very idea of a specification involves the existence of a mass of common knowledge in regard to any material, which knowledge is more or less available to both producer and consumer. If the manufacturer or producer has opportunities which are not available to the consumer, of knowing how the variation of certain constituents in his product will affect that product during manufacture, so also does the consumer, if he is philosophic and is a student, have opportunities not available to the producer, of knowing how the same variation of constituents in the product will affect that product in service, and it is only by the two working together and combining the special knowledge which each has, that a really valuable specification can be made.

8. A complete workable specification should contain the information needed by all those who must necessarily use it, in obtaining the material desired. On railroads this may involve the purchasing agent, the manufacturer, the inspector, the engineer of tests, the chemist and those who use the material. A general specification may be limited to describing the properties of the material, the method of sampling, the amount covered by one sample, and such description of the tests as will prevent doubt or ambiguity.

9. Where methods of testing or analysis or inspection are well known and understood, it is sufficient if the specification simply refers to them. Where new or unusual tests are required, or where different well known methods give different results it is essential to embody in the specification sufficient description to prevent doubt or ambiguity.

10. The sample for test representing a shipment of material should always be taken at random by a representative of the consumer.

11. The amount of material represented by one sample can best be decided by the nature of the material, its importance, and its probable uniformity, as affected by its method of manufacture. No universal rule can be given.

12. The purchaser has a right to assume that every bit of the material making up a shipment meets the requirements of the specification, since this is what he contracted for and expects to pay for. It should make very little difference, therefore, what part of the shipment the sample comes from, or how it is taken. Average samples made up of a number of sub-samples are only excusable when the limits of the specification are so narrow that they do not cover the ordinary irregularities of good practice in manufacture.

13. Re-tests of material that has once failed should only be asked for under extraordinary conditions, and should be granted even more rarely than they are asked for, errors in the tests, of course, excepted.

14. Simple fairness requires that when it is desired that material once fairly rejected should nevertheless be used some concession in price should be made.

15. Where commercial transactions are between honorable people, there is no real necessity of marking rejected material to prevent its being offered a second time. If it has failed once, it will probably fail a second time, and if return freight is rigidly collected on returned shipments, the risk of loss is greater than most shippers will care to incur. Moreover, it is so easy for the consumer to put an inconspicuous private mark on rejected material that it is believed few will care to incur the probable loss of business that will result from the detection of an effort to dispose of a rejected shipment by offering it a second time.

18. All specifications in actual practical daily use need revision from time to time, as new information is obtained, due to progress in knowledge, changes in methods of manufacture, and changes in the use of materials. A new specification, that is, one for a material which has hitherto been bought on the reputation of the makers and without any examination as to quality, will be fortunate if it does not require revision in from six to ten months after it is first issued.

17. In the enforcement of specifications, it is, undoubtedly a breach of contract legitimately leading to a rejection, if the specified tests give results not wholly within the limits, and this is especially true if the limits are reasonably wide. But it must be remembered that no tests give the absolute truth, and where the results are near, but just outside of the limit, the material may actually be all right. It seems to us better therefore, to allow a small margin from the actual published limit, equal to the probable limit of error in the method of testing employed, and allow for this margin in the original limits, when the specifications are drawn.

18. Many producers object to specifications on the ground that they are annoying and harassing, and really serve no good purpose. It is to be feared that the complaint is just in the cases of many unwisely drawn specifications. But it should be remembered that a good, reasonable specification, carefully worked out, as the result of the combined effort of both producer and consumer, and which is rigidly enforced, is the best possible protection which the honest manufacturer can have against unfair competition.

19. Many consumers fear the effect of specifications on prices. Experience seems to indicate that after a specification has passed what may be called the experimental stage, and is working smoothly, prices show a strong tendency to drop below figures prevailing before the specification was issued.

20. A complete workable specification for material represents a very high order of work. It should combine within itself the harmonized antagonistic interests of both the producer and the consumer. It should have the fewest possible requirements consistent with securing satisfactory material; should be so comprehensive, as to leave no chance for ambiguity or doubt, and above all should embody within itself the results of the latest and best studies of the properties of the material which it covers.

Other papers at the Wednesday evening session were those of L. W. Page and A. Cushman on "The United States Road Material Laboratory: Its Aims and Methods," and of W. K. Hatt on "A Preliminary Program for the Timber Test Work to be Undertaken by the Bureau of Forestry, United States Department of Agriculture."

THURSDAY MORNING.

"Specifications for Iron and Steel" was the general subject for the Thursday forenoon session.

Wm. R. Webster, chairman of the committee on Standard Specifications for Iron and Steel, reported progress, and was followed by C. C. Schneider, who commented briefly upon the

specifications for iron and steel structures adopted by the American Railway Engineering and Maintenance of Way Association in March, 1903. Printed copies of these specifications were distributed among the members. The substance of the changes involved in them has been given heretofore in these columns. Mr. Schneider emphasized the importance of proper work in the rolls and in heating furnaces and the final heat treatment of structural products. The cold bending test was regarded by the committee to be indispensable. The departures involved in the new specifications are three: 1. A single grade of steel, with desired tensile strength of 60,000 pounds and an allowable variation of 5,000 pounds. 2. Reduction of ore is omitted. 3. Elastic limit is omitted. The committee could not agree on a new method of testing elastic limit, and the present method being thought unsatisfactory the matter was left open for the discovery of a better one in the future. Wm. R. Webster presented the specifications on steel rails adopted by the American Railway Engineering and Maintenance of Way Association in March, 1902, and the modifications submitted in March, 1903, both of which have already appeared in the technical press. In referring to the modifications Mr. Webster said that the manufacturers were unwilling to make a drop test for each heat and the committee suggested one drop test in five heats. The manufacturers suggested larger holes in heavier sections and larger bolts.

Albert Ladd Colby presented the Standard Specifications of the Association of American Steel Manufacturers, as revised in February, 1903, at Pittsburg. He referred to the first successful effort, in August, 1895, to get an agreement by steel manufacturers to a set of specifications. Revisions were made in 1896 and in 1902 and the last revision was in the present year. These specifications had grown in favor under use and consumers found that steel made under them was as good as that rolled to specifications containing unnecessary requirements. Structural steel of three grades is provided for: rivet steel, with ultimate strength of 48,000 to 58,000 pounds; railway bridge steel, with ultimate strength of 55,000 to 65,000 pounds; medium steel, with ultimate strength of 60,000 to 70,000 pounds.

Wm. Kent reported on the work of the steel specifications committee of the American Society of Mechanical Engineers, appointed at the request of the American Society for Testing Materials. This committee had reduced the sulphur maximum from .05 to .04; its tensile strength requirement was 60,000 pounds for structural steel, with 5,000 pounds allowable variation.

Reading Railway Investigations of Steel Rails.

Robert Job presented the following deductions from steel rail inspections and tests of the Philadelphia & Reading Railway:

1. As to detection of coarse grain in steel rails by means of drop tests: our practice proved beyond any question that ordinary drop test of weight of 2,000 pounds, falling 20 feet upon butts about 4½ feet long and 3 feet between supports does not cause fracture of coarse grained rails, 80 pounds and over, except when brittleness due to other causes, such as piping, burning of steel, etc., is present. Large microstructure is due to slow, undisturbed cooling from a high temperature, and causes lessened ductility and lessened strength under impact. Consequently it should be perfectly feasible so to proportion weight and height of drop as to produce fracture if grain exceed a certain size.

2. As to relation of microstructure to appearance of fractured surfaces: (a) When the fractured surface appears coarse-grained, the microstructure is coarse-grained. (b) When the fractured surface appears fine-grained, the microstructure may or may not be fine-grained. In other words, steel of coarse microstructure may be made to show a fairly fine-grained fracture under certain conditions of fracturing. (c) When the microstructure is fine-grained, the fractured surface appears fine-grained.

3. As to relations between appearance of fracture and poor service wear: in most cases rails of fairly solid steel fracturing in service or giving poor wear have shown coarse-grained fracture, indicating high finishing temperature. In relatively few cases the fracture has appeared fairly fine-grained, but upon polishing and etching a section the structure has always appeared coarse.

4. As to relations between coarse microstructure and poor wearing qualities of rails in service: upon a lot of 75,000 tons of 90-pound rails observed during a period of five years, we have found fifteen times as many fractures in the case of rails having coarse microstructure as in those of a much finer form. We have also invariably found, with equal solidity of steel and with other conditions approximately equal, a marked increase in rapidity of wear of steel of the coarse microstructure as compared with that of the finer.

5. As to relation between degree of shrinkage of rails after hot saw, and service life: (a) Rails with shrinkage of 7 inches and over on 30-foot lengths have shown a relatively large number of fractures and rapid wear. (b) Rails with shrinkage of 6¼ inches or less on 30-foot length, with rapid rolling and without holding between passes, have shown very largely decreased number of fractures together with increased capacity for wear.

6. As to relations between piping of rails and fractures in service and under drop test: a large majority of the rails fractured in service show piping to a considerable extent, either directly upon the fractured surface or else where the cross section is polished and etched.

7. As to tests necessary to insure tough, well-wearing rails: our practice during the past year has shown good results under the following conditions: (a) Absence of brittleness is insured in 90-pound rails by drop test of 2,000 lbs. falling 23 feet upon rail butts about 4½ feet long, 3 feet between supports, one test being made upon each heat, each test butt being taken from the top of an ingot. (b) Toughness and moderately slow wear, if the steel is solid, are insured by enforcing the following practice, viz.: temperature of ingot or bloom to be such that with rapid rolling and without holding before or in the finishing passes or subsequently, and without artificial cooling after leaving last pass, the distance between hot saws shall not exceed 30 feet 6 inches for a 30-foot rail, or a proportionate distance for other lengths. (c) Solidity of steel can be insured only by careful inspection throughout the process of manufacture, especially as regards cropping. (d) Suitable chemical composition is essential to the best service results. For 90-pound rails we prefer about the following, with the ordinary rolling practice: carbon 0.53 percent to 0.63 percent; phosphorus, below 0.07 percent; sulphur, below 0.07 percent; manganese, 0.90 percent to 1.20 percent.

Discussion.

After the specifications for locomotive axles and forgings recommended by the committee of the American Railway Master Mechanics' Association in June, 1903, had been presented by H. F. Clark, chairman, there was a general discussion of the subject.

Dr. Dudley referred to the original specification of the Pennsylvania Railroad calling for 50,000 to 60,000 pounds tensile strength in boiler steel, particularly firebox steel, thousands of tests showing 53,000, 55,000 and 57,000 pounds. The soft material used gave two difficulties, as noted by a careful study of results all over the system. The metal, in the first place, was so lead-like that the staybolt threads did not hold; and in the second place, the sides of the firebox were abraded more or less by the coal. Accordingly the lower limit was raised 1,000 pounds and this had been advanced since, the present specification being 55,000 to 65,000 pounds.

Mr. Kent remarked that the Pennsylvania Co. made the specification originally for firebox steel and gave it its name. Now the requirements were such as to eliminate firebox steel, as they called for flange or boiler steel. In the old days if soft steel was not furnished, the firebox cracked. The manufacturers have now learned not to put so much phosphorus in the steel and the evil of cracking is eliminated.

Dr. Dudley said that 20 or 30 years ago iron fireboxes were used—made of charcoal iron where this could be had. In passing to steel the inclination was to get something as near as possible to iron, with which they were familiar. As the manufacturers have perfected their processes of steel making, consumers were able to get better steel and were specifying a different material from what they were willing to use at the start. Latterly firebox cracks have largely disappeared, which

may be because the washing out is with hot water instead of cold as formerly. The tendency almost everywhere is toward higher carbon steel for boilers. Where it used to be .10 the minimum is now .15 and often .18 and up to .25. For axles the minimum now is .35 carbon and the railroads want to know if they can go farther and get a .45 carbon or possibly .50 carbon steel axle. This is forced upon them by experience with steel in service. Axles are found to break in detail, where steel under .35 carbon is used. The Pennsylvania Railroad makes a chemical analysis of every heat of axles—the number of axles in a heat averaging 55—and for three years no heat of axles has been rejected if the carbon ran as high as .55, even though the specification is .30 to .50. Experience is compelling the use of harder material.

Chas. L. Huston, referring to the tests of the Lukens Iron & Steel Co. in connection with the manufacture of steel, said that the company had some years ago decided in favor of a harder grade of steel for boilers than was generally used, though it was to be taken into account that fuel and water conditions were an important factor. They had noticed a tendency of firebox steel to bulge between staybolts, with starlike cracks extending from staybolt to staybolt. They had thought a tensile strength of 60,000 pounds under general conditions advisable and were glad to find this decision corroborated in the specifications now generally favored. This would not apply, however, to flange steel or to marine work. In heavy plates he thought it best to keep the material soft, especially when heavy presses and dies were to be used in working it. He thought the severe restrictions in sulphur in some of the proposed specifications were not with sufficient reason. It is rather from hot working that any trouble comes. To tie down so strictly on sulphur increases the difficulties of the Eastern manufacturers who have not as low sulphur material at hand as those farther West. He thought steel running .07 in sulphur was as good as that lower in sulphur, though ordinarily it was possible to meet a .04 specification. He considered the single grade of steel, with the tensile requirement 55,000 to 65,000, rather hard on the manufacturer of plates, especially where there was no slabbing mill, the tendency being to get carbon rather high for the thinner plates.

Dr. Dudley recounted some experience with axles. The Pennsylvania Railroad, when it found axles breaking in detail under service, raised the tensile strength to 80,000 pounds, with no specifications as to chemistry, and the difficulty disappeared at once. This was eight or ten years ago, and the axle steel used was almost all acid. More recently, with the extensive use of basic steel, it is found that the specification of .35 to .50 carbon, which the company now has for axle steel, does not give an 80,000-pound steel, but 5,000 to 8,000 pounds lower. The same chemistry in the basic furnace does not give the same physical properties as in the acid process. The difficulty could be relieved by introducing .2 percent silicon, but high silicon in the basic furnace brings troubles the manufacturer does not want. The question now is, shall carbon be increased, even though it give a little more tender steel in the furnace and a little more difficulty in segregation? And a further question would come, whether hot water could be safely turned on a .65 carbon steel.

Steel for Vessels and for Structural Work.

E. Platt Stratton, chief engineer surveyor to the American Bureau of Shipping, was asked to open the discussion on the question, "In what respects do the requirements for structural steel for bridge building and ship building purposes differ?" In Great Britain steel of 62,000 pounds tensile strength had formerly been insisted upon. A reduction to 60,000 pounds had resulted in more satisfactory steel, particularly on keels and intercostal plates. In bridge work the same amount of blacksmithing was not necessary; a material was wanted which would stand all kinds of abuse. He had known of American plates of 58,000 pounds tensile strength in use on vessels which had stuck on boulders and the latter had actually been forced between the frames of the vessel. In the English navy while the requirement of 62,000 pounds was maintained, in the merchant vessel service a range of 58,000 to 68,000 pounds was most satisfactory. The question being asked whether higher carbon steel would resist rust to a greater extent than softer steel, Mr. Stratton replied that this was more imaginary than real.

Mr. Kinkead contended that as iron is less liable to rust than steel, lower carbon steel is less liable to rust than higher carbon. Others took issue with this statement. The noncorroding property of iron in the example that had been cited was ascribed to the fact that the iron was not free from slag, and the coating of slag was a protection. This was just the contrary of the statement that the purer the metal the less corrosion. To the above explanation by Mr. Christie Mr. Kent added that it was well established that the purer iron is the faster it will corrode. Pure charcoal iron rusts faster than iron higher in metalloids. As between steel of 60,000 pounds and steel of 70,000 pounds tensile strength he thought the difference in corrodibility inappreciable.

Mr. McLeod thought a range of 55,000 to 65,000 pounds tensile strength for structural steel a good compromise if the idea of a one grade is to prevail. Having in view the requirements of ship builders, possibly 58,000 to 68,000 pounds might be taken; to go below 58,000 pounds for such material would involve more trouble with plates when vessels get upon the sand. Mr. Wickhorst had found two classes of failures in fireboxes: first, a corrugating effect, not a sudden failure, but gradual and in detail; second, sudden rupture. The detail failure was generally in low carbon material—.15 or less in carbon; the sudden failure was in harder steel running .25 to .35 in carbon. On the C. B. & Q. Road the average tensile strength for such steel was about 60,000 pounds.

Mr. Royal referred to an experience of the Imperial Railway of Japan. Two fireboxes that had failed were shipped to this country and the steel tested, photographs taken, etc.; and 30 gallons of the water used was shipped over for examination. The trouble was pitting in large patches, but the investigation failed to show the reason. The firebox sheets failed longitudinally. This was reported to be due to the water and bad mandling. In recent years the Imperial Railway of Japan had adopted specifications calling for 58,000 to 64,000 pounds tensile strength for firebox steel. Flanges except the throat sheet are required to be made with a hydraulic power press, this being a recent feature of foreign specifications.

Gus C. Henning, commenting on several points brought out in the discussion, said that cracks in plates around staybolts came from punching steel. Drilled boiler plates will show no such cracks. As to the matter of corrosion: Pure iron rusts fastest. Notice the fractures of soft steel and tool steel; the soft steel rusts first, the tool steel a long time afterwards. Coming to the questions raised concerning breaking strength, tenacity, etc., the speaker said that it was not necessary to know about the tenacity of material but at what point it changes shape under load, and what its ductility is. The more ductile the material is under load the better it is. The factor of safety commonly used is only a guess. The question is, to what point can the material be loaded without changing its shape. The yield point may be determined with absolute accuracy. The higher the proportion of the yield point to tenacity, with the same ductility the better the steel will be, especially under impact. Yield point is not elastic limit. The former can be observed while the tensile test is going on. If railroad laboratories would determine the yield point of all their axles they would find in the weak axles a relatively low yield point. Heat treatment and uniformity of operation are all important. Generally material is used in an overstrained condition because it is not reheated and reannealed after work is put upon it.

The question of the differences between steel for bridges and for ships was referred to by Mr. Christie. Primarily the structures are similar, but the conditions of use differ greatly. One is anchored rigidly with little motion. The other is a mobile structure, subject to all the stresses and strains resulting from the motion of wind and water. The troubles spoken of in connection with firebox steel might occur more frequently in ships than in structures on land. The shipbuilder should have a little harder material. If a single specification were important the limits on structural steel might be advanced say 3,000 pounds. In summing up the discussion of the morning, Mr. Christie moved the reference of the question of bridge and ship steel to Committee No. 1 for a report, in connection with

the whole question of steel specifications.

PIG IRON SPECIFICATIONS.

Thursday afternoon was given up by many of the members and guests to trips by carriage and boat for viewing the picturesque environs of the Water Gap. The pig iron sub-committee of the American committee of the International Association for Testing Materials took advantage of the unoccupied time to hold a meeting, which was attended by about a score of those interested either as blast furnacemen, as chemists, testing engineers, or other representatives of the pig iron consumers. The chairman of the sub-committee, Edgar S. Cook, of Pottstown, Pa., presided, and N. B. Wittman, of Potts & Wittman, Philadelphia, acted as secretary, having these respective offices on the sub-committee.

A report was presented of a meeting of the sub-committee held at Philadelphia, June 2, at which it was decided to recommend that all buying of pig iron hereafter be on analysis, rather than on fracture or appearance. The following were recommended as analyses of the various grades named, and to be followed where no analysis was specified—all other elements apart from silicon and sulphur to depend on the brand of the iron:

	Silicon.	Sulphur.
American Scotch	Above 3.00	.03
No. 1	2.50 to 3.00	.03
No. 2 X	2.00 to 2.50	.045
No. 2	1.75 to 2.25	.055
No. 3	1.50 and over	.075

Mr. Cook, the chairman, urged the necessity of some agreement on the basis of grading and on the allowable variation. He had known iron to be refused by a foundry because it was .1 percent above or below the specified silicon—this on a falling market. He thought no furnaceman would guarantee that his analysis would come within 0.25 percent in silicon of the analysis of the foundry's chemist. Some allowance should be agreed upon to cover differences in sampling, personal equation, etc.

A resolution by Albert Ladd Colby was adopted as follows, with a view to securing uniformity in sampling:

"In contracts in which pig iron is sold on chemical analysis, it is the opinion of this association that each carload, or its equivalent, be considered as a unit, and that in said carload each two tons of iron shall be represented by a pig, said pigs to be selected at random, so as to fairly represent the carload of iron. Furthermore, that the drillings be taken so as to fairly represent the surface of each pig; and that the sample analyzed consist of an equal quantity of drillings from each pig, well mixed and ground before analysis."

There was a long discussion of the grading scheme tentatively submitted by the sub-committee, Messrs. Moldenke, Cook, Scott, Wood, Field and others taking part. There was some objection to the sulphur limit, as being rather high. Mr. Scott, who prepared the J. I. Case Threshing Machine Co. specifications, said that .05 was the highest allowable sulphur in the pig iron bought by that company. This, with the sulphur taken up from the coke in the cupola, gave as high sulphur as could be tolerated in the casting. Castings with .095 sulphur can be machined, but when the sulphur gets up to .125 percent it is impossible to machine the foundry product.

Mr. Cook remarked that foundrymen could regulate sulphur in the cupola if they paid as much attention to it as to some other things.

The secretary referred to some correspondence which preceded the Philadelphia meeting of June 2. Mr. Flather, of the McCormick division of the International Harvester Co., was quite in accord with the proposal to do away with fractures as an indication of grade. He thought too much latitude was allowed on sulphur in the proposed scheme. W. H. Hearne, of Matthew, Addy & Co., thought the proposed grade definitions would not satisfy the Southern furnaces. He proposed a different range in sulphur, giving somewhat more latitude. As to the designations proposed, he thought the substitution of Nos. 1, 2, 3 and 4 grades better, the No. 2 X being known only in the Eastern part of the country. As finally changed the recommendation of the sub-committee as to the silicon and sulphur contents of the various grades was as follows:

	Silicon.	Sulphur.
No. 1 Foundry	2.75	.035
No. 2 Foundry	2.25	.045
No. 3 Foundry	1.75	.055
No. 4 Foundry	1.25	.065

A resolution referring to this classification, and one that led to a long and entangling discussion, related to the allowable variation from the silicon and sulphur content as thus stated. It was amended a number of times and was finally adopted in a form which was to this purport: That in the absence of specifications, or an agreement between buyer and seller, the variation permitted in delivery of the above grades shall be 10 percent in silicon and .01 in sulphur. A further variation of 10 percent in silicon or .01 in sulphur shall subject the seller to a penalty of 1 percent of the price on each element so varying.

This is promulgated to the trade for adoption as a basis of settlement between buyer and seller, where errors arise due to differences in methods of sampling or analysis or to the personal equation in sampling and analyzing. At the evening session of the general meting, Mr. Wood, as chairman of the committee on cast iron, presented the action of the afternoon meeting and it was adopted.

THURSDAY EVENING.

Nickel steel and pipes in rail steel were the subjects discussed at the Thursday evening session. John McLeod, of the Carnegie Steel Co., opened the discussion on nickel steel by referring to the constant necessity put upon the steel manufacturer of increasing the tensile strength of his material; and as failures have occurred in various lines of service, increase of section is resorted to; but to this there are limits. Recourse has now been had to nickel steel and to other alloys to make sure against failure. Much is yet to be learned in the use of nickel steel; only a few phases of its behavior have been even in a measure demonstrated. When used to oppose abrasion it is much superior to plain open-hearth steel. Nickel steel rails have been in use for six years. It is found that they will outwear three or four carbon steel rails. The railroad that has had the nickel rails in use has ordered 5,000 tons more and expects to get good results. These rails are to be the ordinary rail with nickel added. The railroad engineers feel that perhaps the manufacturer may have gone too far in the matter of hardness with nickel steel and an effort may be made to lower the carbon.

Albert Ladd Colby, of South Bethlehem, Pa., presented an admirable paper reviewing the experience both in Europe and in this country in the manufacture and use of nickel steel. Its characteristics were described with considerable detail. Nickel steel is chiefly distinguished from simple carbon steel by its high elastic limit. High carbon steels show greater additions to elastic limit and tensile strength than low carbon steels with the same addition of nickel. The toughening quality of steel is increased by the addition of nickel, without any increase in hardness, giving a steel that can be machined and that at the same time is rigid, tough, strong and elastic. Nickel steel plates resist the effect of punching. A ¾-inch nickel steel rivet will replace a 1 1-16 to 1 1-8 carbon steel rivet, thus reducing the section of the plates. There is also a greater shearing strength. Nickel steel segregates much less than carbon steel and checks the segregation of other elements. The grain is finer than in carbon steel ingots. A comparison as to strength and other properties is shown in the following table:

	Tensile Strength.	Elastic Limit.	Elong., Percent in 2 in.	Contrac. of Area Percent.
Annealed carbon steel	109,500	51,440	19.50	36.31
Annealed nickel steel	100,330	66,720	25.00	54.56
Oil tempered carbon steel	129,360	67,230	17.50	38.53
Oil tempered nickel steel	103,890	76,390	25.00	61.56

After enumerating the uses of nickel steel that are most familiar, Mr. Colby spoke of the latest use of nickel steel in the United States, the Bethlehem Steel Co. having arranged to furnish nickel steel to the Shelby Tube Co., from which

the latter will manufacture non-corrosive seamless tubing for locomotive boilers and condensers. While the first cost will be increased (probably to three times that of ordinary steel tubes, though the speaker could not be exact about this), the tubes would be completely non-corrosive and proof against pitting. When they were finally taken out of use they could be sold at the price of steel plus 20 cents a pound for the 30 percent of contained nickel.

Dr. Dudley spoke of the experience of the Pennsylvania Railroad with nickel steel. The first rails put down were on a half mile of freight track on the Kittanning curve. Nickel steel rails lasted three years, as against 10 months for ordinary carbon rails. The defect so far noticed with nickel steel rails was the tendency to "spall off" along the side of the head. This might be expected of a carbon steel rail that was near a pipe in the ingot, but its cause was not clear. The Pennsylvania Railroad is planning to put some nickel steel into locomotive tires and it had been tested in piston rods with good results. Nickel steel stands abrasive wear much better than carbon steel. As yet it is too early to say whether it stands better than carbon steel under alternating stresses.

The Rolling of Piped Rails.

A paper on "The Casting of Pipeless Ingots by the Sauveur Overflow Method," printed in full elsewhere in this issue, was read by Prof. Sauveur. There followed a discussion upon the rolling of piped rails, in which Mr. Sauveur took exception to present methods in steel works, as well as the practice in inspection and testing. The usual custom of discarding 10 percent of the ingot was condemned, the speaker claiming that this still left from 20 to 30 percent of the pipe, and made it certain that the first rail would be a piped rail. It is almost farcical, the speaker contended, to introduce such refinements as had come into the specifications for steel rails as long as the fact was ignored that one rail in six was defective. In lieu of requiring the manufacturer to cut off a larger percent of the ingot, the railroads should prescribe that the drop test be conducted on the first rail from each ingot. That being the weakest one of the series is the one to test. Manufacturers, he contended, should not go on making piped rails, and railroads should not go on buying them.

Mr. Job showed two photographs of etched specimens from piped rails. The pipe in each case extended through the web to the bottom of the rail. In 75 percent of the cases of fractured rails—a thing of rare occurrence—pipes have been found to be the contributing factor, aided by other weaknesses. Mr. Job thought that the rail from the top of the ingot was the only one to take for a test. This did not delay the mill, as had been thought. A 2,000 pound weight, dropped 23 feet upon material 3 feet between supports had proved an excellent detector of pipes and combining this with the testing of the rail from the top of the ingot, should give a good check.

Mr. Christie recalled that in the early days of the Bessemer process when blooms were rolled after reheating there were no troubles. Difficulties came in largely from the hasty methods introduced in the effort to make steel manufacture a greater commercial success. It should not be said that the mill cannot afford to take the time necessary to prevent defects. In the days when heavy hammers were used in the mill these difficulties were not present. His own idea would be to introduce in the blooming mill a machine with something of the function of the old-fashioned squeezer in the puddling mill, so as to squeeze the ingot when on the way to the blooming mill.

Mr. Sauveur replied that high carbon steel would not weld under such pressure where there was a pipe; the pipe would be there just the same. Mr. Whiting corroborated this, saying that the presence of oxides prevented the welding of a piped ingot.

Mr. Martin, of the Carnegie Steel Co., remarked that good practice would not show such ingots as those of which Mr. Sauveur had presented views. If he thought these were representative of the ingots worked in rail mills he would prefer walking to riding on a railroad. He questioned the applicability of the experiments made to ordinary practice in Bessemer mills.

Mr. McLeod was of opinion that inspectors representing consumers could obviate most of the troubles that existed in respect to rail steel by watching the bloom in the mill and seeing that sufficient was cut off. One man can't be on duty all the time to do this, but two men could. The blooming mill is the place to criticise and night is a better time than day. The representatives of the railroad companies must share with the steel companies any blame there is, for no mill superintendent would ship a rail knowing it to be piped. Tests are relative; therefore if a specification is made requiring that the top rail be tested, let it be remembered that the others will be better than that one.

Dr. Dudley raised the question whether the proper time was allowed to elapse in the Bessemer works between the addition of the ferro-manganese and the pouring of the ingot. Chemical reactions require time, and he had often questioned whether in the Bessemer process, after the addition of ferro, the reacting substances had time enough to get through the mass of steel. He believed much trouble was due to the oxide remaining, and the solution lay in allowing more time between the additions and the solidification of the metal.

At the conclusion of the discussion Col. E. D. Meier, of New York, was introduced and asked the co-operation of the society in the efforts of the American Boiler Manufacturers' Association to secure the amendment of present national legislation relating to the inspection of material for the boilers of steam vessels.

CAST IRON SESSION.

The meeting of Friday morning for the discussion of cast iron was called to order by Dr. Dudley, who felicitated the association on the presence of so many experts along the lines of cast iron. Mr. Cook's paper on "Machine Cast Sandless Pig Iron" was read by the author. It appears elsewhere in this issue.

There was some discussion on this paper by Messrs. Vannier and Scott, who desired information on the average quantity of sand on sand-cast pig iron as it left the blast furnace. Mr. Cook stated that this had never been determined with any degree of accuracy, but that as a rule much less sand was shipped than is allowed to the founder, so that he has the advantage in the sand allowance given by the blast furnaces. As to the amount of slag and the fusibility of the sand on the pigs as experienced by the foundries, this depended upon sand into which the pigs were cast. A purely silicious sand left a skin that was so infusible that it often remained intact after the iron had run out, even coming down that way when the bottom is dropped. A sand full of lime and clay, on the other hand, melted and slagged off readily in the cupola. Mr. Cook said, in answer to a question, that in time one could learn to judge sandless iron by its appearance—not in fine limits, perhaps, but neither was this possible in the case of the fracture of sand cast pig.

Physical Properties of Malleable Castings.

Dr. Richard Moldenke, secretary of the American Foundrymen's Association, read the following paper on "The Physical Properties of Malleable Castings as Influenced by the Process of Manufacture":

"As the matter of specifications for cast iron and finished castings is attracting considerable interest, it may perhaps be well to call attention to the necessity for a special clause in the one for 'malleable cast iron' limiting the processes allowable in its manufacture. The necessity for this action is the result of recent developments along the line of heat treatment given the hard castings. As a general proposition, it has been long known that the hard castings may be either annealed a long time at the regulation temperature, or only a short time if the temperature be considerably higher. The results, while apparently the same, in that the combined carbon of the castings becomes the 'temper carbon' characteristic of a good piece of 'malleable,' are in reality not so reliable as might be expected in the case of the higher heat. There are several processes now in use which aim to reduce the period of anneal, to cheapen the cost and to make quicker deliveries. Unfortu-

nately, however, whether from an insufficient knowledge of the science of heat treatment, or from lack of uniformity of material, the castings produced are not always good 'malleable' and lead to much loss and annoyance.

"Until we know more of the behavior of the iron going into the malleable casting, when heated beyond the ordinary annealing temperatures, it would be well to call for a minimum number of hours during which the work to be tested for acceptance has been given the full heat of the ovens. For light work this might be placed at 60 hours, and for ordinary or heavy material at 72. When the makers of malleable castings, who anneal their work a few hundred degrees higher and thus shorten the period can prove to the buyer that they can do this successfully every time, this clause relating to length of time under full heat can be modified or done away with. So far, however, these varieties of the malleable casting seem to be sold as steel, and very likely to consumers who cannot tell the difference.

"For the benefit of the foundry industry, it is to be hoped that the heat treatment of the malleable casting be thoroughly investigated, and on a commercial scale. Much of value would be learned this way, and the spasmodic attempts to reduce the cost of annealing by varying the method of carbon conversion be brought down to a scientific basis and subsequent business results.

"In addition to the annealing question, there must be considered the melting process to be followed. Three methods are now in use here. The cupola, air furnace, and the open-hearth processes. Lately a modification of the Bessemer process is being introduced, but it is too new to be taken into account yet. The crucible process, which undoubtedly gives the best results, is obsolete in this country. Contact with the fuel during melting cannot do otherwise than injure metal so low in silicon as this must be, and hence the cupola process gives the poorer grade of 'malleable,' the higher annealing temperature required not improving matters either. For important work this class of malleable is always excluded. Where, however, there is no necessity to resist shock, and the factor of safety is amply large, there is no reason why cupola malleable should not be used, and about a half a cent or so a pound be saved.

"As between the air furnace product and that of the open hearth, the latter, when produced properly, is undoubtedly the best, and the industry is gradually working in that direction. The expression 'produced properly' is used advisedly, as the mistake of using steel melters for getting out 'malleable' heats is made only too often. The result is an attempt to get a reaction between the oxygen introduced with the carbon of the bath, with the result that the former remains and poor iron is produced. The malleable process should not be made a refining process, in spite of the prevalent theories to that effect. The reduction of the total carbon undoubtedly improves the tenacity of the castings, but this is best accomplished by the addition of steel scrap. The temperature of the melt is unfortunately not sufficient, even in the open-hearth furnace at the time of pouring, to bring about the carbon-oxygen reaction completely, and hence the metal is affected injuriously. Were it steel, the addition of ferro-manganese would soon mend matters, but unless to remove undue sulphur, this should be kept away from 'malleable.' A plentiful application of muscle to get a quick and even melt is what is wanted for malleable work, and hence while it is good to have an open-hearth expert about to preserve the furnaces, he should not run the heats, a muscular Hungarian doing much better.

"The air furnace product, though not so good as that of the open-hearth, on account of the longer duration of the melting period, is nevertheless serviceable for the best class of work, and hence no distinction need be made in drawing up specifications. Attention to this difference is only called here to benefit those who may have trouble with their installations. Personal experience with both classes of castings for many years would indicate that the open-hearth material has the advantage over the air furnace product by about two thousand pounds per square inch in tensile strength, this figure being the average taken from a large number of samples cut from castings of both kinds. As it is undesirable, however, to run the tensile strength too high, say, not over 52,000 pounds per square inch or thereabouts, and air furnace iron can be made to touch this point readily, there is no immediate cause for worry. A moderately strong iron is, in fact, better able to resist shock, and therefore specifications should only give the minimum tensile strength, say 40,000 pounds per square inch. The highest limit obtainable has reached 63,000.

"The near future will doubtless bring out much on the process question in malleable, and indeed a good set of specifications covering the best practice will do much to hasten it on."

Discussion.

H. E. Diller's paper on "Cast Iron for Dynamo and Motor Frames" was then read by the author as given in another column. It was followed by a brief paper on "Cast Iron" by H. E. Field.

Prof. Howe's paper of last year on "The Constitution of Cast Iron," was next discussed by Professors Campbell and Sauveur, who went into the constitution of the carbon compounds in steels of little carbon up to those of iron saturated with carbon, that is, white cast irons. Prof. Sauveur illustrated his remarks with a large series of diagrams and bromide enlargements, while Prof. Campbell exhibited some of the finest photographs of micro-sections it has been our pleasure to see. Especially the reproductions of sections cut at an angle which show the gradation of materials from skin to interior were highly instructive.

The meeting was then declared open for a general discussion of all the papers presented, especially that of Mr. A. E. Outerbridge on the importance of adopting standard sizes of test bars for determining the strength of cast iron, which in the absence of the author had to be read by title, but had been given in substance to the members previously.

Mr. Scott opened the discussion by calling attention to the fact that it was useless to ask all the interested parties to agree upon a standard method of making shop tests of cast iron, as each man had his own ideas on the subject, and could not well be asked to throw away the experience of years along his lines to adopt a new method. However, the proposition of Mr. Wood to adopt a so-called "arbitration bar" which would serve all purposes of domestic and international trade was something which he heartily advocated. Dr. Moldenke next explained the work of the American Foundrymen's Association on these lines, and how it strove to obtain facts which would allow the preparation of bars as free from external varying influences as could be made. How the 1½ inch diameter bar cast on end was best suited for the softer irons, and larger bars for the harder irons, the idea being to get bars as large as expedient to get results which could not be called artificially strong. He was satisfied, however, that the arbitration bar was something badly needed, and felt that if the 1½ inch round bar, slightly turned off to remove surface cracks, cast on end to prevent the variation of strength between top and bottom of the bars cast flat, such a bar would be in line for general adoption as a standard. Inasmuch as it was fair and not being used except for trade contracts and in disputes, special pains could be taken to have it made just right. He heartily endorsed this stand, which seemed to meet with general approval, and certainly was a long step ahead in the right direction, and in no way interfered with individual liberty of action in the shop for the daily work.

Mr. Henning in reply to the statement of Dr. Moldenke that the tensile bar would in all likelihood be discarded for official testing on account of the difficulty of getting reliable methods of thus testing cast iron, brought out the fact that this could now be done with extreme accuracy, though with quite considerable cost, a special lathe doing the turning, and spherical clamps arranged reversed from the usual method giving a proper grip.

After further discussion by Messrs. Field, Wood, Scott, and Henning the meeting adjourned.

The National Tube Co. exported last month through New York, Philadelphia and Baltimore 4,200 tons of pipe. These figures represent an increase of more than 35 percent when compared with the shipments made to different parts of the world during May. The principal June exports of pipe went to Europe, where over 3,000 tons were forwarded.

THE LABOR SITUATION.

Pittsburg Machinists to Meet.

(Special Telegram.)

PITTSBURG, July 8.—P. J. Conlon, first vice president of the International Association of Machinists, arrived in Pittsburg yesterday morning and has been interviewing leading employers with a view to gaining further concessions. He claims to have assurances from a number of prominent ones that further concessions are possible, including two more holidays (New Year's and Decoration Day), on which double time is paid, also double time instead of time and a half on Sundays. There has been some talk of a 7½ percent instead of a 5 percent advance being granted. Conlon has called a mass meeting of machinists in Old City Hall, Pittsburg, for Thursday night, at which it is expected a formal proposition from the employers will be presented embodying the concessions they will make. The presumption is that the proposition will be accepted. There is no official information of the result of the vote of the grand council, but no doubt it was against a strike at least until a resort was had to the present negotiations.

Must Protect Rights of Labor.

William Sweeney, a member of the Compressed Air Workers' Union, was sentenced last week by Judge John A. Blair, Common Pleas Court, in Jersey City, to six months in the penitentiary and a fine of $100 for an assault on John Blesar, a non-union man, who was at work in the North River tunnel in the recent strike of the compressed air workers and laborers. Judge Blair said to Sweeney:

"If you stood alone in this matter the court might be inclined to leniency, but you represent a body of men who consider themselves above the law. Every man has a right to sell his labor for what he pleases, and should not be interfered with in so doing. The question of wages is one between the employer and the employed, and cannot be dictated by any body of men. This court will protect the man who is working for a livelihood whether he belongs to a union or not. The right to labor must be secured as guaranteed by the law. The practice of persons considering themselves superior to the law and trampling upon the rights of others is becoming too common. Men who want to labor honestly should be protected. The only grievance you had against this man was that he was a laborer and you assaulted him, in spite of the fact that the constitution guarantees him that right and happiness in its pursuit."

Pittsburg Molders Want to Strike.

A mass meeting of the molders of the Pittsburg district, to the number of over 1,300, was held to take action on the refusal of the foundrymen to grant the increase in wages asked by the men. Their new scale provided for a minimum of $3.30 a day and 25 cents per day increase for those receiving more than $3.30. The molders voted not to accept the compromise of 10 cents advance offered and will strike if the national officers of the union, at a meeting to be held in Cincinnati July 13, authorize such action. The machinists of Pittsburg have taken similar action, subject to approval of national officers.

Marine Machinists' Strike at New York.

The strike of the machinists engaged on marine work in the port of New York and vicinity, which began June 1 is still on. The demand was for a $3 minimum and an increase of 5 percent to those receiving $3 a day or over. At a conference between New York Metal Trades Association representatives and a committee of the International Association of Machinists, the demand was refused. The New York Metal Trades Association has succeeded in filling almost all the places of the strikers and some of the shops are now unaffected by the strike.

Labor News.

Employes of the Empire Steel & Iron Co.'s furnace, Macungie, Pa., have accepted a slight cut in wages.

The strike of the employes of the Milwaukee Boiler Co., Milwaukee, Wis., has been settled with the assistance of the state board of arbitration. An agreement giving the men a fifty-five hour week, time and one-half for over time, double time for holidays and Sundays, and also providing against sympathetic strikes or boycotts was signed.

The molder's strike in the Aultman Co.'s plant, Canton, O., ended a few days ago. The shop will remain an open one. The union molders have taken their old jobs and the imported men have been sent home.

The annual wage scales of the Amalgamated Association of the Iron and Steel Workers went into effect July 1, and all the plants in the country are reported in full operation.

Notices have been posted by the Bellefonte Furnace Co., and the Nittany Iron Co., of a reduction of 10 cents per day on all employes at furnaces and ore mines.

The Parkersburg Iron & Steel Co., Parkersburg, W. Va., the McClure Tin Plate Co., Washington, Pa., the Alcania Tin Plate Co., Avonmore, Pa., the Cleveland Hardware Co., Cleveland, and the Southern Car & Foundry Co., Anniston, Ala., have signed the scales of the Amalgamated Association for a year.

The Inland Steel Co.'s plant at Indiana Harbor has been shut down on account of a strike of machinists for an 8-hour day.

The blast furnaces of the Columbus Iron & Steel Co., Columbus, O., were banked for an indefinite time July 4 on account of labor troubles. Five men were discharged the previous evening and the remainder refused to go to work. The immediate answer of the management was the shutting down of the plant. The general manager said that it had been decided to stop work until the company could ascertain whether it could manage its business or whether the employes would run it for them.

OBITUARY.

A telegram was received in Cleveland Wednesday, July 8, from Mt. Clemens, Mich., announcing the sudden death of Henry Hansen, associate editor of *The Foundry*. Apoplexy was the cause of death. Mr. Hansen was well known among foundry interests throughout the United States. Further reference to his work will be made later.

Col. George Church died June 27 at his home in Great Barrington, Mass. He was born in Connecticut in 1826. During the war he was one of the owners of the Richmond Iron Works Co., and later became interested in the Lenox Iron Furnace, Lenox, Mass.; the Ramapo Wheel Foundry Co., and other industries.

George S. Morison died at his home in New York City, July 1st, after a long illness. Mr. Morison was born in New Bedford, Mass., Dec. 19, 1842. He was graduated from Harvard in 1863. His most important work was as an engineer of great bridges—notably five across the Mississippi, ten across the Missouri, and the bridge over the Ohio at Cairo, Ill. He was a member of the Isthmian Canal Commission, to which he was appointed by President McKinley, the Manhattan Bridge Commission and of several engineering commissions appointed by President Cleveland. He was a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers and a member of other engineering and scientific societies.

Augustus E. W. Painter, at one time one of the most prominent iron manufacturers and financiers of Pittsburg, died July 4 in Allegheny, aged 60 years. Mr. Painter retired from active business after the absorption of his company by the American Steel Hoop Co.

A. C. Cass, first vice president and traffic manager of the Colorado Fuel & Iron Co., died July 4 at Redstone, Cal., at the summer home of John C. Osgood, where he had been visiting. Death was due to a general breaking down of the system from overwork. He was 53 years of age.

Illinois Steel Co.'s New Bessemer Record.

The Bessemer department of the South Works of the Illinois Steel Co. on the night turn of July 26 produced 2,024 tons of ingots and 180 heats, breaking its own twelve-hour record of 1,894 tons and 175 heats made on the day turn of June 24.

The directors of the Susquehanna Iron & Steel Co., Columbia, Pa., have decided not to pay the semi-annual dividend of 3 percent. The board set aside $50,000 for the new pipe mill at Columbia, which started in operation July 6.

CANADIAN IRON AND STEEL PRODUCTION IN 1902.

The American Iron and Steel Association report, now coming from the press, presents statistics of the production of pig iron and steel in Canada in 1902. The total production of pig iron in 1902 amounted to 319,557 gross tons, against 244,976 tons in 1901 and 86,090 tons in 1900—an increase of 30 percent in 1902 over 1901. Of the total production in 1902, 302,712 tons were made with coke and 16,845 tons with charcoal. A little over one-third of the total production was basic pig iron, namely, 107,315 tons. The Bessemer pig iron made amounted to about 9,000 tons. Spiegeleisen and ferromanganese have not been made since 1899.

The following table gives the total production of all kinds of pig iron in Canada from 1894 to 1902, the statistics for each year having been received directly from the manufacturers. Prior to 1894 the statistics of the production of pig iron in the Dominion of Canada were not collected by this Association.

Years	Gross tons	Years	Gross tons	Years	Gross tons
1894	44,791	1897	53,706	1900	86,090
1895	37,829	1898	68,755	1901	244,976
1896	60,030	1899	94,077	1902	319,557

On Dec. 31, 1902, the unsold stocks of pig iron in Canada amounted to about 20,000 gross tons, as compared with 59,472 tons at the close of 1901 and 12,465 tons at the close of 1900. Of the unsold pig iron on hand on Dec. 31, 1902, over 19,000 tons were coke pig iron.

On Dec. 31, 1902, Canada had 14 completed blast furnaces, of which 7 were in blast and 7 were idle. Of this total 9 were equipped to use coke for fuel, 4 to use charcoal, and 1 to use mixed charcoal and coke. In addition 1 charcoal and 5 coke furnaces were being built or were partly erected on Dec. 31, but work on some of the coke furnaces was suspended.

The Algoma Steel Co., Ltd., of Sault Ste. Marie, Ont., one of the constituent companies of the Consolidated Lake Superior Co., commenced the erection of two charcoal and two coke furnaces at Sault Ste. Marie in 1901. The charcoal furnaces were to be 70 by 14 feet and the coke furnaces 90 by 21 feet. Subsequently work on the coke furnaces was suspended and one of the building charcoal furnaces was converted into a coke furnace, the size being changed from 70 by 14 feet to 80 by 15½ feet. The company now expects to have its charcoal furnace ready for blast in June and its coke furnace in July.

The Cramp Steel Co. Ltd., has put in the foundations for a blast furnace at Collingwood, Simcoe County, Ont. The company expects to have the furnace ready for operation in the fall of 1903. Coke from the United States will be used for fuel and Bessemer pig iron will be made. The daily capacity of the furnace will be about 250 gross tons.

The Nova Scotia Steel & Coal Co. Ltd., of New Glasgow, Nova Scotia, broke ground in June, 1902, for a new furnace at Sydney Mines, Cape Breton, Nova Scotia. The furnace will be 85 by 17 feet and will have a daily capacity of about 200 tons of basic and foundry pig iron. Coke will be used and red and brown hematite ore will be obtained from Nova Scotia and Newfoundland. It is expected that the furnace will be ready for blast in September, 1903. The company now has a furnace at Ferrona, with an annual capacity of 33,000 tons.

The Londonderry Iron & Mining Co., Ltd., of Londonderry, Nova Scotia, is the successor to the Londonderry Iron Co. Ltd. It is rebuilding Furnace A, at Acadia Iron Mines, and expects to blow it in in July, 1903. The furnace will be 75 by 17 feet and will have an annual capacity of 48,000 tons of foundry iron. The company does not contemplate blowing in Furnace B in the near future, but may rebuild it later on.

Production of Steel in Canada.

The total production of steel ingots and castings in Canada in 1902 was 182,037 gross tons, against 26,084 tons in 1901, an increase of 155,953 tons. Bessemer and open-hearth steel ingots and castings were made in each year. Almost all of the open-hearth steel reported in 1902 was made by the basic process. The direct castings made in 1902 amounted to 5,288 tons.

The following table gives the production of all kinds of steel ingots and castings in Canada from 1894 to 1902, in gross tons.

Years	Gross tons	Years	Gross tons	Years	Gross tons
1894	25,685	1897	18,400	1900	23,577
1895	17,000	1898	21,540	1901	26,084
1896	16,000	1899	22,000	1902	182,037

The large increase in the production of steel in Canada in 1902 over 1901 was caused by the starting up of the new open-hearth steel plant of the Dominion Iron & Steel Co. Ltd., at Sydney, Cape Breton, Nova Scotia, which first produced steel on Dec. 31, 1901, and of the new Bessemer plant of the Algoma Steel Co. Ltd., at Sault Ste. Marie, Ont., at which steel was first made on Feb. 18, 1902. The latter company has two 6-gross-ton Bessemer converters, which were operated for a few months in 1902, producing in all 44,537 gross tons of ingots. The company also has a rail mill which first made Bessemer steel rails on May 5, 1902, and which also ran for a few months in that year, producing 32,878 tons. In addition this company produced 1,558 tons of other rolled products in 1902. The Dominion Iron & Steel Co. made 99,377 tons of basic open-hearth steel ingots, 48 tons of steel castings, and 86,424 tons of blooms, billets, and slabs. It did not make steel rails. It has ten 50-gross-ton open-hearth furnaces.

Production of Rolled Iron and Steel in Canada.

The production of Bessemer and open-hearth steel rails in 1902 amounted to 33,950 tons, against 891 tons of open-hearth rails in 1901; structural shapes, 423 tons, against 4,386 tons in 1901; cut nails made by rolling mills and steel works having cut-nail factories connected with their plants, 114,685 kegs of 100 pounds, against 126,891 kegs in 1901; plates and sheets, 2,191 tons, against 2,857 tons in 1901; all other rolled products, excluding muck and scrap bars, blooms, billets, sheet bars, etc., 119,801 tons, against 98,206 tons in 1901. Changing the cut-nail production to gross tons, the total quantity of all kinds of iron and steel rolled into finished forms in Canada in 1902 amounted to 161,485 tons, against 112,007 tons in 1901.

The following table gives the production of all kinds of iron and steel rolled into finished forms in Canada from 1895 to 1902.

Years	Gross tons	Years	Gross tons	Years	Gross tons
1895	66,402	1898	90,308	1901	112,007
1896	75,043	1899	110,642	1902	116,485
1897	77,021	1900	100,690		

On Dec. 31, 1902, there were 19 completed rolling mills and steel works in Canada and 1 plant was being erected. Of the completed plants 2 were equipped for the manufacture of steel castings only, 4 for the manufacture of Bessemer or open-hearth steel ingots and rolled products, and 13 for the manufacture of rolled products only. The plant in course of construction was being equipped for the manufacture of Bessemer and open-hearth ingots and finished rolled products.

The Canada Switch & Spring Co. Ltd., of Montreal, has changed its name to the Montreal Steel Works, Ltd., and has practically discontinued the manufacture of steel castings by the Bessemer process and will hereafter make steel castings by the open-hearth process only. Its Bessemer castings were produced in a 3,000-pound modified acid converter, which was first put in operation in 1897. In 1901 the company erected and put in operation one 15-gross-ton acid open-hearth furnace, and in 1903 it built another 15-ton acid furnace. Nearly all the steel castings made by the company in 1902 were produced by the open-hearth process.

The Page-Hersey Iron & Tube Co., Ltd., is erecting a plant at Guelph, Ont., for the manufacture of wrought-iron pipe. It is the intention of the company to add in the near future a number of puddling and busheling furnaces and 2 trains of rolls (one 12 and one 16-inch) and to manufacture skelp for use in its pipe mill. Small quantities of bar iron may also be made. The plant will have an annual capacity of

about 17,000 gross tons of finished rolled material and 15,000 tons of wrought-iron pipe.

The Cramp Steel Co., Ltd., expects to have two 18-gross-ton basic open-hearth steel furnaces and 2 trains of rolls (one 10 and one 18-inch) in operation at its new plant at Collingwood Ont., late in the spring of 1903. When completed the works will make steel rails, beams, plates, merchants bar iron, rods, shafting, etc.

The rolling mill formerly located at Guelph, Ont., and operated by the Guelph Iron & Steel Co. Ltd., was removed to London, Ont., in the fall of 1902, and is now being operated at the latter place by the London Rolling Mill Co. Ltd. A 14-inch roughing mill has been added, and the plant can now turn out annually about 15,000 gross tons of merchant bar iron and steel and 6,000 tons of bolts, nuts, and hinges. Operations at London were commenced in March, 1903.

John C. Osgood, formerly chairman of the executive board of the Colorado Fuel & Iron Co., has made a statement to which he says that he continues his interest in the company, and will give all the support he possibly can to the new management, and is not planning a combination to oppose the Colorado Fuel & Iron Co.

The Pittsburg Safe Co. has decided to build a plant in South Connellsville, Pa., all the stock allotted to the town having been taken. The company will employ about 100 men.

The Louisville & Southern Indiana Bridge Co. has been organized by prominent citizens of Louisville and New Albany with a capital of $1,500,000 for the purpose of constructing a railway bridge between Louisville and New Albany.

The creditors of Aultman, Miller & Co., Akron, O., manufacturers of harvesting machinery, have given the trustees permission to sell the plant to Judge W. A. Vincent, of Chicago, presumed to represent the International Harvester Co., for $640,000. It is said that the plant will be operated and that $250,000 will be spent on improvements.

The Newman Manufacturing Co., Cincinnati, capital $10,000, has been incorporated to manufacture metal ware, by Samuel Newman, Peter Kearn, Lee Kohn, Wm. Kohn and R. H. Zschau.

The Navy Department has awarded to the Gas Engine & Power Co., of Morris Heights, N. Y., the contract for building the gunboat Paducah at its bid of $355,000. The same company took the contract for the sister ship of the Paducah a month ago at $295,000.

The Ohio Forge Co., Cleveland, recently incorporated, does not expect to build at present, but is rearranging a large two-story building and equipping it with steam hammers and other machinery. The company will do a general business in forging and tool smithing. The manager will be James M. Clem, who recently resigned a position with the Warner & Swasey Co.

Receiver James Smith, Jr., of the United States Shipbuilding Co., after filing his bond in the sum of $100,000, took possession of the property. He says that it will be his earnest endeavor to conserve the important interests of the company and put it on a solid financial basis. At the request of the receiver, Lewis Nixon has decided to remain as president of the company.

E. A. Pfleuger, of Akron, O., has been appointed receiver of the Ohio Steel & Iron Specialty Co., Cuyahoga Falls, O. The application for the appointment of a receiver was made by B. Emmerman, of Cleveland, who had a claim for $695, Emmerman Bros., Akron, who had a claim for $556, and Wilkoff Bros., of Youngstown, who had a claim for $38,000.

Hickman, Williams & Co., Chicago and Cincinnati, have been appointed agents for the Graham Iron Co., Graham, Va., for all territory west of Pittsburg. The Graham Iron Co. is now running on basic iron.

THE HANGING ROCK REGION.

IRONTON, O., July 6.—The Ironton Disc Plow Co. has purchased five acres of land adjoining the Marting Iron & Steel Co. plant on which it will erect its factories. Ground was broken today.

The Norfolk & Western announced a few days ago that it would send no more empties into the Elkhorn and Flat Top coal and coke regions until the congestion of traffic could be relieved. There are thousands of cars of coal and coke now in the field tied up for lack of motive power. The furnaces of this section are all laying in large stocks of coke.

By a decision handed down last week by Common Pleas Judge Middleton, the stockholders of the Lawrence Furnace Co. are empowered to remove John Peters, Jr., as manager upon the satisfaction of his claim of $13,635. In giving his decision, Judge Middleton expressed the opinion that the firm was insolvent. The company's property closed down several weeks ago.

A conference will be held at Ashland, Ky., tomorrow, between the officials of the Ashland steel plant and the iron workers, looking to a settlement of the difficulties that have caused an enforced idleness of all the leading iron industries of that city and Ironton. The opinion is expressed that an agreement will be reached, in which case the wire and wire nail mills will resume as soon as they can secure material.

The local rolling mill of the Republic Iron & Steel Co. did not resume on July 1, as announced when a suspension was ordered, but the statement comes from Supt. Simonton that the company has no intention of abandoning the mill, but will place it in operation as soon as enough orders are booked to warrant it.

The Scioto Fire Brick Co. has decided to establish another plant at Sciotoville, O., to cost about $30,000. The company has already three large plants.

The Structural Steel Car Co., Canton, O., passed into the hands of a receiver July 3. For several months efforts have been made to refinance the company, which had a capital stock of $1,000,000. These plans resulted in failure. Counsel for the company say that the creditors would lose nothing by the receivership, and that with the subscription of stock outstanding and the assets on hand the indebtedness would all be paid, leaving the plant to be sold for the reimbursement of stockholders. The indebtedness is put at about $85,000. Hiram Doll, of Canton, is the receiver.

Following the recent announcement by Lord Rosebery that public spirited citizens have offered to contribute $300,000 for the erection of a scientific university in London comes the statement of a scheme for a completely equipped metallurgical teaching and research works as a memorial to Bessemer, the discoverer of the process named after him. It is stated that the scheme will form an integral part of the wider university plan initiated by Wernher, Beit & Co.

Both the iron foundry and the new steel plant of the Diamond Drill & Machine Co., of Birdsboro, Pa., continue to run night and day, and they are shipping castings in from one to four weeks. It has been found necessary to build another open-hearth furnace to accommodate the increasing volume of business. The machine shop also reflects the general prosperity, being operated to its fullest capacity.

The Pottstown Passenger Railroad Co., of Pottstown, Pa., has purchased from the Ball Engine Co., Erie, Pa., a 450-h. p. engine arranged for direct connection to a Westinghouse railway type generator.

The Falkenau-Sinclair Machine Co., of Philadelphia, makes testing machines of all kinds, and a circular just to hand describes the recent productions in cement testing machinery. These are built in various styles, automatic directing reading, etc., and the machines shown have some attractive features to the eye of the mechanic. The equipment is designed to apply the load smoothly so that there is not a succession of minute shocks due to the impact of falling weights and in this way the briquette develops its full strength.

PIPELESS INGOTS BY THE SAUVEUR OVERFLOW METHOD*

BY ALBERT SAUVEUR AND JASPER WHITING.

The formation of a cavity technically called a "pipe" in the upper part of steel ingots, under the ordinary method of casting, is too well known an occurrence to call for any description. If a "piped" ingot be cut in two longitudinally, this defect will appear as shown in Fig. 1. The great advantage which would result from being able to cast pipeless ingots is, of course, appreciated both by producers and consumers, witness the strenuous attempts which have been made to eliminate this defect. In medium high and in high carbon steel the pipe occupies from 20 to 40 percent of the length of the ingot. In the manufacture of armor plates and of some expensive forgings as much as 40 percent of the ingot is discarded and in this way only metal free from pipe is converted into finished product. In the manufacture of other implements however, it is safe to affirm that a sufficient amount of metal to insure absolute freedom from pipe, is very seldom rejected. Hence the danger of turning out defective material. It is our opinion that a very large proportion of the failures of steel implements of all kinds in the process of manufacture, in the testing room or when in use, is due to the presence within them of this defect. The production of pipeless ingots, therefore, would not only do away with the rejection of a large amount of metal, a most important item, but it would also greatly reduce the production of defective implements. The commercial value of this last consideration will, we believe, be readily granted. From the knowledge that they are not placing on the market finished implements containing this hidden flaw—a cause of much weakness and of probable eventual failure—the manufacturers should derive a feeling of security which they alone can fully appreciate.

FIG. 1.

In the production of many implements where the cost of the work required is many times greater than the cost of the metal, as for instance in the manufacture of saws and many other tools, the handling of pipeless ingots would result in a saving considerably greater than would at first appear, because the presence of a pipe is in many cases only discovered when the implement is nearly ready for the shipping room, that is, after a large amount of expensive labor has been put upon it, and the cost of this labor is a clear loss to the manufacturer. Producers of such implements will, we believe, readily appreciate the importance of this consideration.

In the method now to be briefly described, it is believed that a practical means has been found for the casting of pipeless ingots. It will be sufficient for the purpose of this paper to recall in a few words the cause which induces the formation of the pipe.

After molten steel has been cast into an iron mold, the metal in contact with the bottom and the sides begins first to solidify. After a relatively short while the top of the ingot, which is exposed to the cooling action of the air, also becomes solid and the ingot now consists in a rigid metallic shell holding a mass of molten steel as shown in Fig. 2. As the cooling proceeds this solid shell increases in thickness, but since steel, like most substances, undergoes a considerable contraction in passing from the liquid to the solid state, the mass of metal which when liquid was sufficient to fill the space within the solid shell, will, after it has in turn solidified, be unable to fill it and a cavity must necessarily be formed in the upper part of the ingot. It is evident, therefore, that the formation of the pipe is due to the fact that the top of the ingot solidifies while a considerable amount of metal below it is still liquid. Once the top has become rigid the contraction of the liquid interior in passing to the solid condition must necessarily result in the formation of a cavity or pipe. By retarding the solidification of the top we should, therefore, decrease the size of the pipe and if it were possible, in a practical way, to maintain the top liquid to the very last, that is, until all metal below it has solidified, the formation of the pipe should be altogether prevented. Efforts have been made in this direction, such for instance as covering the top of the ingot immediately after casting with fuel or with molten slag, or in preheating the top of the mold. All such attempts, however, resulted only in a slight decrease in the dimension of the pipe and were accompanied by practical objections which more than offset the small gain effected.

The aim of the present method is to maintain the top of each ingot liquid until all metal below has solidified and to do so without in any way interfering with the conduct of the mill operations or adding to their cost. The method consists

FIG. 4.

FIG. 5.

in so connecting a number of molds that the molten metal can overflow from one mold into the next, while pouring is continued in the same mold until any desired number of molds beyond have been filled.

In Fig. 3 is shown a diagram representing in elevation a number of molds which we shall suppose so connected that after one mold has been filled, if the supply of metal be continued into it, the excess of metal will overflow into the next which will in turn be filled. To take a particular case, let us suppose that we cast the steel into mold No. 1, and that after it has been filled we continue pouring into this same mold until we have cast into it sufficient metal to fill the next five molds. After mold No. 1 has been filled, the metal will overflow into mold No. 2, and when this one has been filled it will overflow into mold No. 3, and so on until six molds have been filled. It will be seen that by this method we maintain a flow of molten metal running over the tops of the solidifying ingots, and therefore retard the solidification of the tops which is our desideratum. This should result in a reduction of the pipe, and, if sufficient molten metal be passed over the tops, in the complete obliteratum of this defect. The molten metal flowing over the tops of the ingots acts after the fashion of a sinking head, feeding the pipe, and therefore preventing its formation.

It will be seen that in the example we are considering ingot No. 1 will have enough metal cast upon it to fill five molds, ingot No. 2 enough to fill four molds, ingot No. 3 enough to

*Read at the Delaware Water Gap meeting (July, 1903) of the American Society for Testing Materials.

fill three molds, and so on to the last ingot, which had no extra metal passed over its top. The amount of molten steel flowing over the tops of these ingots decreases, therefore, as we pass from the first to the last ingot, and it should be expected that the effectiveness of the method in eliminating the pipe should also be greatest in the case of ingot No. 1 and should then gradually diminish.

It is well known that the segregation of impure metal in the upper part of steel ingots, that is in the piped portion, is due

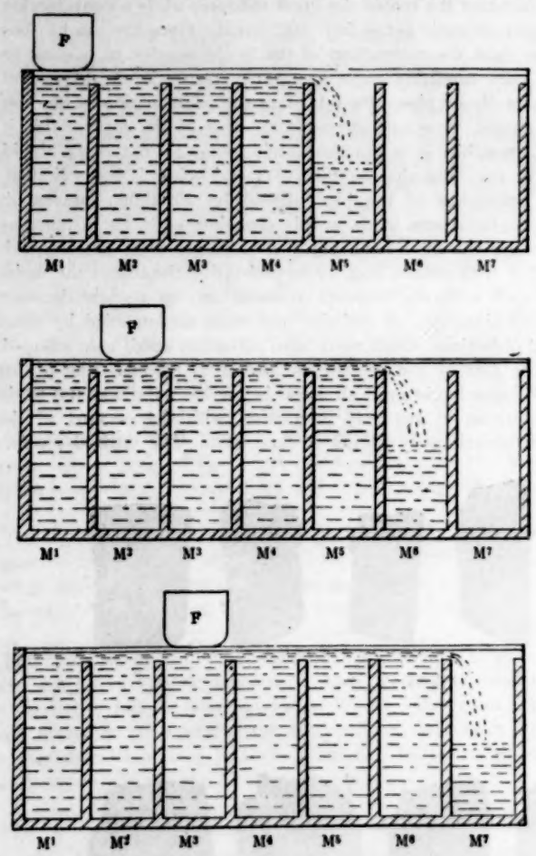


FIG. 3.

to the fact that the impurities present in the metal, especially the phosphides, sulphides and carbides, are more fusible than the metal itself, and have therefore a tendency to collect in the portion of the ingot remaining molten longest. In the overflow method these impurities should naturally rise to the very top of the ingot and should then be carried away by the flow of molten metal to be discharged into the next empty mold. Here however they should be diluted so largely by the metal from the crucible or ladle as to have but a very slight effect upon the average composition of the ingot. We have not as yet had the opportunity of testing the effect of the method upon the segregation of impurities, but from these theoretical considerations it should naturally be anticipated that if it does not prevent it altogether it should greatly diminish it.

The Overflow Method with Crucible Steel Ingots.

Numerous experiments were conducted with crucible steel ingots in order to ascertain the practical value of the overflow method. The results obtained in casting six ingots, after the manner just described, are shown in Fig. 4, which is the reproduction of a photograph of the broken tops of these ingots. These ingots measured 3½x5½x22½ inches and weighed 100 pounds. The steel cast contained from 0.9 to 1.00 percent carbon and was produced in a regenerative crucible furnace.

Ingots of this size and grade cast in the usual manner had a pipe extending on an average about 8 inches downwards. Turning our attention to the ingots cast by the overflow method, it is seen that No. 1 and No. 2 ingots are absolutely free from pipe. They are solid masses of metal to the very top. The metal which was cast upon these ingots had caused their top to remain liquid until the metal below it had become solidified, preventing thereby the formation of a pipe. No. 3 and No. 4 ingots show a small cavity measuring about 1 inch, while No. 5 ingot has a 4-inch pipe. No. 6 was not, of course, materially improved. These experiments were repeated a number of times and the results obtained were in every case very similar.

The results which had been anticipated from purely theoretical considerations are, therefore, fully confirmed. From the appearance of No. 5 ingot we infer that the passing over the top of an ingot of sufficient metal to fill one more mold by causing it to overflow into it will reduce the length of the pipe some 50 percent, while the passage over the molten top of an ingot of enough metal to fill four more molds will result in the complete elimination of that cavity.

In Fig. 5 is shown a number of pipeless or nearly pipeless ingots obtained by the overflow method.

In casting six ingots then in the manner just described, while the first two ingots will be pipeless, the remaining ingots will have small pipes of increasing length. It may be readily conceived, however, that the overflow method may be conducted in a more continuous manner, so that enough metal will flow over the tops of all the ingots to make them pipeless, namely, in the present case, enough metal to fill four or five additional molds. If for instance, returning to Fig. 3, after having filled six molds by pouring in No. 1, the pouring be shifted to No. 2 and enough metal be cast to fill mold No. 7, and then the pouring be shifted to mold No. 3 and enough metal cast to fill No. 8 and so on, it is evident that the necessary amount of metal will have flowed over the top of each ingot to prevent the formation of a pipe.

It is quite obvious that the amount of metal which must flow over the top of an ingot in order to make it pipeless will vary with the size of the ingot, the temperature of the metal, the rate of cooling, the composition of the steel, etc. In each mill the most desirable manner of conducting the overflow method will have to be ascertained by a few preliminary experiments.

A suitable connection between molds had to be devised, and this important point was finally solved with complete success by using the molds illustrated in Fig. 6. They will be seen to be three-sided molds, each mold moreover being in two sections for convenience in stripping. When these molds are properly assembled and fastened together, each two adjacent molds have a common wall between them at the upper part of which a groove is provided for the overflowing of the metal from one mold into the next. These molds have given very good satisfaction. They are, if anything, less expensive than the ordinary style of molds used in crucible steel manufacture.

It was found undesirable to teem directly into the molds, as in doing so the metal is agitated to too great a depth during the teeming to allow of the quiet, undisturbed, cooling desired. To avoid this disturbance, caused by the fall of the

FIG. 2.

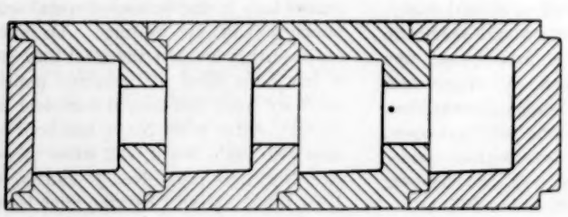


FIG. 6.

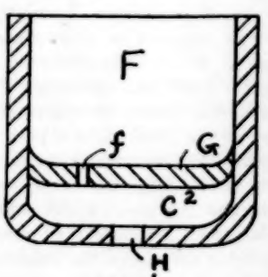


FIG. 7.

metal into the mold, a receptacle was used shown in Fig. 7, and which consists of a crucible-like appliance provided with a false bottom. Each bottom is provided with one hole of suitable size. This crucible rests upon the mold into which it is desired to teem and the steel is poured into it in the usual manner. The metal flows into the lower chamber and from it into the mold. The relative sizes of the holes are so regulated that the lower chamber is being constantly drained. In this way the fall of the metal is broken and the steel in falling into the mold produces very little agitation of the molten top.

The overflow method is now being installed at the steel works of the Simonds Mfg. Co., of Chicago, where the experiments were conducted. It was quite natural to first apply the method to the casting of crucible steel ingots, but experiments are now under way to ascertain its value in casting Bessemer open-hearth steel ingots.

Replying to a recent inquiry from this office, the Cleveland Pneumatic Tool Co. writes: "It would take a wise man to answer your very easily asked question. Regarding the readjustment of values, it is a very gentlemanly way of expressing the fact of squeezing the water out of over-capitalized corporations in this country. It cannot be called a 'readjustment of values,' because the value was not in the capitalization of these companies formed. The whole idea was a stock speculative transaction, and we do not believe the dear public have been so eager to bite at the tempting bait, consequently these over-capitalized corporations are up against it. Legitimate transportation, manufacturing and agricultural conditions of this country were never better than they are today. The pessimists who are looking for trouble are people who are involved in some of these transactions which, as we have said before, are speculative rather than industrial. They have sown their seed; now let them reap their crop. Since the first of January, 1903, the business of this company has increased over 50 percent of 1902. As an example of our prosperity, the orders which we received yesterday, June 29, aggregated over $3,000, and they were for the two articles, chippers and riveters, which we manufacture. We can see no clouds in the business horizon of any concern that is on a legitimate basis. We do believe there is trouble ahead for all of the concerns who are capitalized from one to ten times over their actual value."

D. L. Wilson, president of the C. D. & P. Tel. Co., Pittsburg, who recently bought the Continental Iron Works, Wheatland, Pa., at auction for about $40,000, was to receive the deed for the property, and make payment, on Wednesday of this week. A report from Sharon states that application will be made July 18, for a charter for the Shenango Iron & Steel Co., capitalized at $200,000, and names as being interested Mr. Wilson, A. W. Herron, of the Fort Pitt National Bank, Pittsburg, Mason Evans, Youngstown, and Samuel McClure, manager of the Stewart Iron Co., Sharon. Mr. Wilson denies, however, that he is interested in any such company, or has any knowledge of it, although admitting his identity as the purchaser of the plant.

At Newark, N. J., Judge Kirkpatrick decided on June 30, that the United States Shipbuilding Co. is insolvent and that its directors had failed to take proper steps to protect the bondholders and seemed to be without ability to raise funds. He therefore decided to appoint receivers and asked counsel to indicate their preference. The directors of the company met on the same day but did not act on the resignation of President Nixon. It is stated that the receivership will not prevent the carrying out of improvement plans.

The American Bridge Co. has lost contracts amounting to $1,000,000, as the result of the failure of the board of aldermen of St. Louis to pass an ordinance to permit the carrying out of a plan submitted the Terminal Association to build an elevated railroad for the Eastern railroads entering St. Louis, so as to avoid a trip through the tunnel. The plans provided for the trains to run direct to the exposition grounds. An effort will be made to have the aldermen reconsider their action, but this is not likely to change the situation.

CAST IRON FOR DYNAMO AND MOTOR FRAMES.*

BY H. E. DILLER.

In designing a dynamo or motor, the engineer uses a large factor of safety in his calculations, which in some instances is even greater than 30 percent. This extra allowance is necessitated partly by his limited knowledge of the exact properties of the materials which he puts into his machine, but mostly by the irregularities in their quality. These irregularities in the iron and steel used are sometimes so great that notwithstanding the large margin allowed by the designer's calculations, a dynamo of the same type as many which have previously made a splendid showing in the shop test will, when

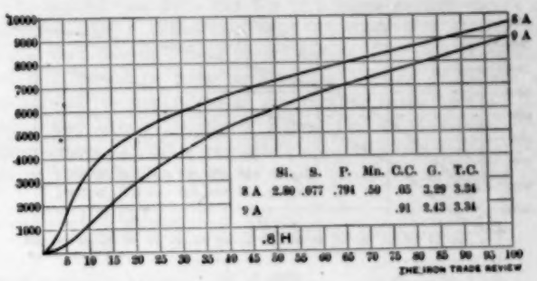


FIG. 1.

put on trial, fail to develop the required output. So beside the waste of material and other losses entailed in using an excessive amount of metal in the machine, there occasionally is the expense of dismantling the dynamo after it is tested, to add more turns of wire to the field coils.

To get a good material of a regular quality should be the earnest effort of every manufacturer of electric power apparatus. The permeability and the hysteresis loss of iron and steel depend primarily on the heat treatment they have undergone, and on their chemical composition. In making sheet steel for armatures and laminated pole pieces, and steel castings where high permeability is required, it is endeavored to keep the amount of elements other than iron as small as possible. Sheet steel is made with as high as 99.7 percent of iron, while the regular casts of some steel foundries contain more than 99.6 percent of iron. There are of course some steel works and steel foundries which sell steel containing large amounts of the undesirable elements, but in general we can look for considerably over 99 percent of iron in steel to be used for

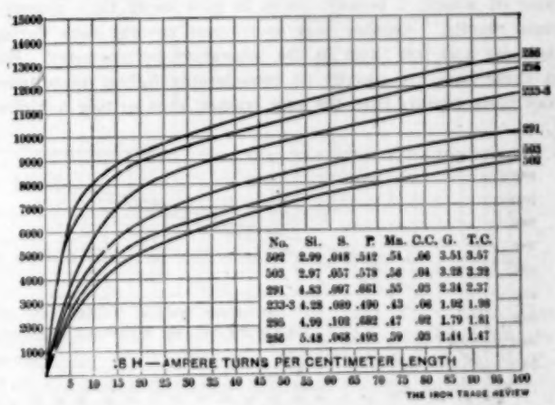


FIG. 2.

electrical purposes. In these purer steels the magnetic qualities are dependent more on the mechanical and heat treatment to which the steel is subjected than on variations in its chemical composition.

But in cast iron we have a somewhat different problem. Here the elements present, other than iron, are a far greater factor in determining its physical and electrical qualities; amounting as they frequently do to over 7 percent. Of carbon, which exerts the most influence on its permeability, there is frequently more than 3.5 percent, existing in the two destructive states—graphitic and combined; while in steel for

*Read at the Delaware Water Gap meeting (July, 1903) of the American Society for Testing Materials.

electrical purposes the amount of carbon should always be less than .2 percent, all of which exists in the combined state. If we wish to know something of the heat treatment a steel casting has received we must have recourse to the microscope to show us the size of the crystals and the form in which the carbon is blended with the iron to form the pearlite. On the other hand the combined carbon in cast iron will tell us a pretty clear story of the rate of cooling, and of its physical condition. When, too, the iron casting is not annealed, while all steel for frames, armatures and pole pieces should be annealed.

After this rather long introduction I would like to consider more specifically the requirements of cast iron for use

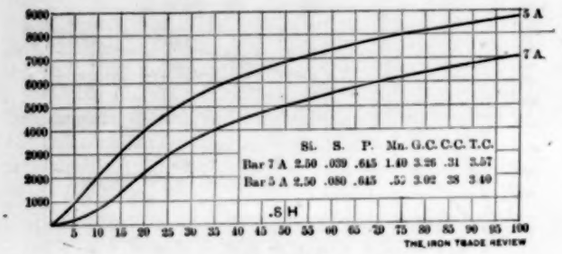


FIG. 3.

in dynamo and motor frames, and the problems it presents to the designer, more especially as to its magnetic properties. In large frames the strength and rigidity of the metal are usually of primary importance; while in medium and small size frames the strength problem is almost if not entirely eliminated and the permeability of the iron is the governing factor, especially where an effort is made for a neat machine which will present a pleasing appearance and where excessive weight is prohibitory, as in the case of ceiling motors and machines to be placed in tall factory buildings. For both of these qualities—strength and high permeability—the thing most essential is a low percentage of total carbon in the iron.

A company which buys its castings from different foundries gets castings which vary widely in their magnetic properties, and even when a company makes its own castings, it is only with the greatest care in the mixing and melting of the iron that it is able to get a regular product. These irregularities in the iron make it greatly desirable for the engineer to know the permeability of the dynamo and motor frames. To tell this, there have been several kinds of permeameters designed, none of which, I believe, claim to give more than approximate results. Another way is to cast several bars during the heat and test them in the laboratory permeameter. But as these bars are usually of considerably lighter mass, they cool more rapidly than the cast frames, thus getting a higher

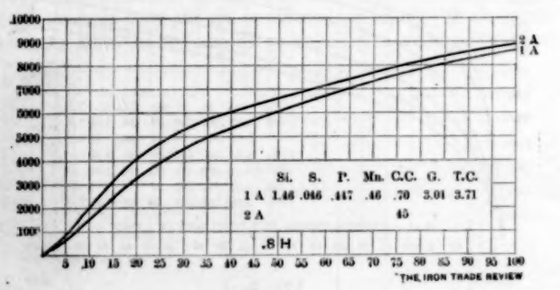


FIG. 4.

percentage of combined carbon and consequently have a lower permeability than the iron in the frames. This difficulty can be considerably overcome by casting a bar on each frame, but this necessitates considerable labor in clipping off the bars and turning them to the required dimensions.

But I believe the magnetic properties of cast iron depend almost entirely upon its chemical composition, and think that, with a good knowledge of iron and with a proper care as to the melting and mixing of the charge, a regular grade of first-class castings can be made, which will have practically the same permeability. In a general way, we may say that the less of each element, other than iron, in an iron casting, the higher is its permeability.

The amount of sulphur is kept as low as possible in all castings, except occasionally when high sulphur is desired to increase the chilling properties of the iron. This rule is a good one for iron to be used in making dynamo and motor frames. But the amount of sulphur in the ordinary cast iron is so small that of itself it does not noticeably affect the permeability of the iron. Indirectly, it is very detrimental, as it tends to increase the combined carbon and causes blow holes. However, its effect of combining the carbon can be neutralized by putting a larger amount of silicon in the iron.

The phosphorus in cast iron varies from about .15 percent to 1.4 percent. But in ordinary machinery castings we generally find about .5 percent. This is a considerable amount, but does not greatly affect the permeability of the iron. In looking over the curves given by different irons whose phosphorus contents range from .16 percent to 1.2 percent, I could trace very little effect on the permeability due to the phosphorus.

With manganese it is quite different, for its presence in large amounts markedly lowers the permeability of iron. It is difficult to get bars which vary in manganese, but still have the other elements the same. After comparing a great number of curves and making due allowance for the variation of the other elements in the iron, it seemed that a variation in manganese makes almost as much difference in the permeability as does an equal variation in the amount of combined carbon. Plate No. 1 shows two curves given by iron with the manganese—in 5 A, .59 percent, and in 7 A, 1.4 percent. The total carbon in 7 A is slightly higher than in 5 A, and will about neutralize the effect of the higher combined carbon in 5 A, so we can practically attribute the difference in permeability to the difference in manganese. At 20 ampere turns per cm. length, this difference amounts to about 1,800 lines per sq. cm., and the curves then run almost parallel through the higher densities. The effect of graphite seems also to be the same in the lower as in the higher densities, but we find a difference in the effect of combined carbon which is not nearly as strong in the higher as in the lower densities. The curves on plates Nos. 2 and 3 show good examples of this.

The percentage of carbon existing in cast iron as graphite or combined carbon depends on the amount of manganese, sulphur and silicon present; the size of the casting, and the rate of cooling. With enough silicon in the iron, we can reduce the combined carbon to less than .10 percent. The silicon of itself has very little detrimental effect on the permeability of the iron, and so it seems best to have a large percentage of silicon in the iron in order that we always have a dead soft casting. This will eliminate one of the most serious causes of irregularity in the iron, as the amount of combined carbon present has a marked effect on the permeability. Curves on plates II. and III. are good illustrations of this. Curves 1 A and 2 A are from different bars cast from the same ladle of iron, as are also curves 8 A and 9 A; the higher combined carbon in 1 A and 9 A being obtained by a faster rate of cooling.

With the amount of combined carbon controlled by the silicon, and the percentage of manganese easily regulated in making up the charge for the cupola, the only considerable cause left for irregularity in the permeability of the iron is the amount of graphite present. It is difficult to regulate this, about the only way being the use of low carbon pig iron, or the addition of steel scrap to the charge. But the fact that the iron takes up carbon from the coke it is melted with, and that the iron melts at a lower temperature than the steel, makes it difficult to control with a great degree of accuracy the amount of carbon in the casting. On chart No. IV. are some curves showing the effect of graphite on the permeability. These curves I selected out of a great number because the combined carbon in all cases is so low as to be practically negligible, the manganese too is quite regular, and the curves are, I believe, good representatives of each class of iron. There is a big difference in the amount of graphite in these irons, varying as it does from 1.44 percent to 3.51 percent, and also a wide difference in the permeability. The point which seems most interesting is that instead of increasing in

direct proportion as the graphite decreases, there is a great change in the permeability when the graphite is about 2 per-cent, while the effect on the permeability due to difference in graphite is considerably smaller in iron having over 2.5 per-cent or under 1.7 percent of graphite.

Some of the foundries making rolls and special gray iron castings, and nearly all malleable iron founders find it profitable to use the open-hearth furnace, even though it does cost a little more to melt their iron than it would if they used the cupola. Probably it will not be long until the manufacturers of electrical machinery will find it desirable to install open-hearth furnaces to do the work of the cupolas, and then the metallurgist can have the satisfaction of making regularly a good casting of high permeability.

The Duluth Iron & Metal Co., Duluth, Minn., has been awarded the contract to furnish about forty tons of steel rails for the government work at the south pier of Superior entry; the price being $37.50 per ton. The government is finding difficulty in securing bidders for manufactured steel products. The locomotive recently purchased from an Eastern concern cannot be delivered until about September. A number of large concerns to which plans and specifications were sent have replied that the time limit would bar them out of the competition as they had all the work they could do for a number of months.

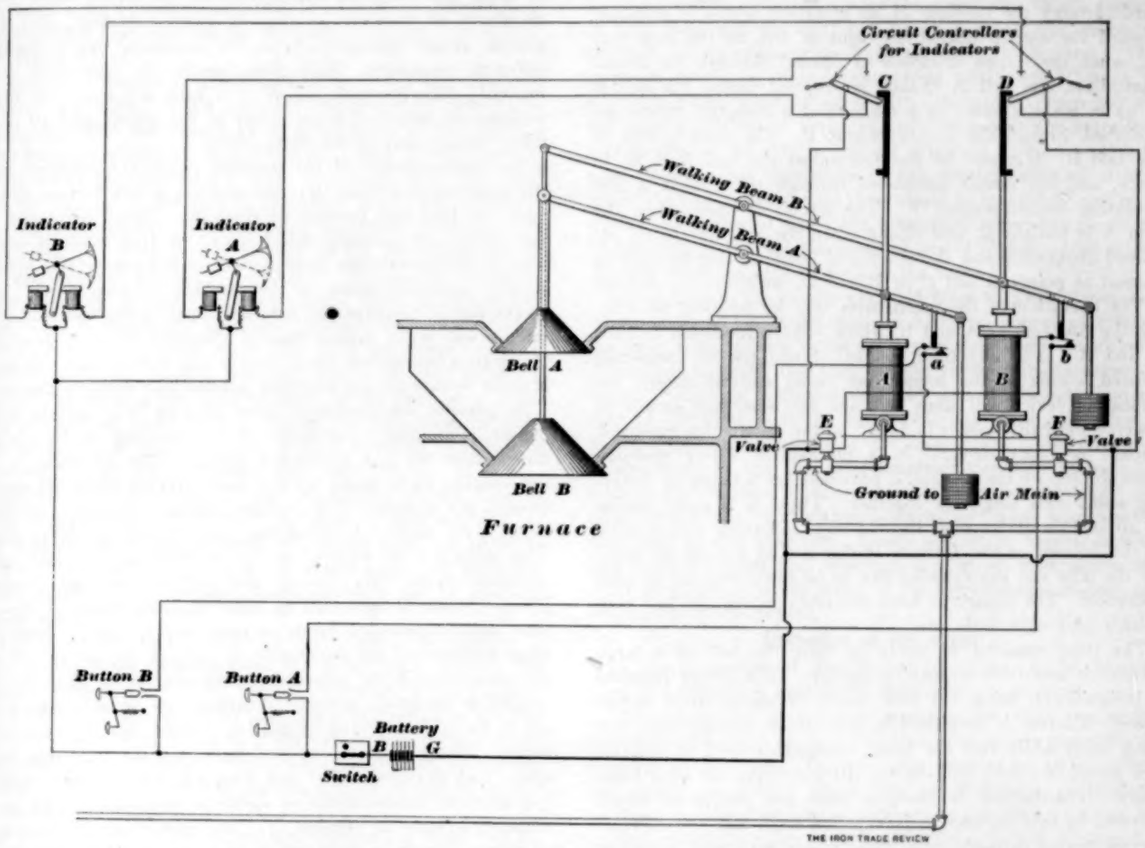
It is announced at Salt Lake City that a new corporation, to be known as the Utah Iron & Coal Co., has acquired over 5,000 acres of iron ore land in Utah, and will build blast furnaces and a steel plant. Senator W. A. Clark, of Montana, and A. B. Lewis, of Salt Lake City, president of the Royal Gold & Copper Co., and C. C. Parsons, of Denver, are among those mentioned in connection with the new enterprise. The capital stock of the company will be $20,000,000, all common shares.

The Tennessee Coal, Iron & Railroad Co., for six months ending June 30, will, it is estimated, show a surplus, after charges and depreciation, of approximately $1,500,000 compared with $596,000 of the previous year.

ELECTRO-PNEUMATIC OPERATION OF FURNACE BELLS.

As has been shown in descriptions of modern blast furnace plants appearing in these columns from time to time, latter-day construction provides for dispensing with workmen on the furnace top. Accidents have been frequent, and the substitution of mechanical means for charging furnaces, the control being in the hands of an operator at the bottom of the furnace, is rapidly going on. Another feature of latter-day construction is the substitution of the double bell and hopper for the single bell and hopper, this change increasing the efficiency of the furnace by the saving of the gas that formerly escaped whenever the bell was lowered.

The use of two bells has led to a more perfect means of operating them. When two bells are used, it is always desirable that one should be closed before the other is opened, and this should be done without any liability of failure on the part of the apparatus, or any mistake made by the operator. The Union Switch & Signal Co., of Swissvale, Pa., manufactures an electro-pneumatic apparatus that accomplishes this in a satisfactory manner. It is strictly interlocking and one bell cannot be lowered until the other is in place. This company has just finished installing this apparatus on six furnaces for the Lackawanna Steel Co., of Buffalo, N. Y., which are among the largest and most modern in the country, and are the first to be equipped with apparatus of this description.



ELECTRO-PNEUMATIC APPARATUS FOR OPERATING BLAST FURNACE BELLS AT THE PLANT OF THE LACKAWANNA STEEL CO., BUFFALO.

The illustration shows the device as connected to the operating air cylinders used to lower the bell, also the arrangement of wiring contacts, valve-operating mechanism, indicating device, batteries, etc. The valve-operating device is located at the bottom of the operating cylinders. The duty of this valve mechanism is to open and close the air valve leading to the operating cylinders. The operating cylinders are single-acting, taking air at the bottom of the piston only. This raises one end of a walking beam, thereby causing the lowering of the bell attached to the other end of the beam. The bell is raised to the closed position after the air is exhausted from the cylinder, by the force of gravity acting on the counterweights attached to the beam on the same end as the piston.

The circuit controller N is entirely protected from the

weather. When the bell is down the circuit controller opens the circuit as shown at *a* and *b*, and also opens or closes the indicating circuit as shown at C and D. Two arms P are attached to a guide M that operate the shaft of circuit controller by making contact with the arm O when the bell is lowered or raised. The guide M is attached to the same beam as the piston of the operating cylinder, and in line with the piston.

The push button and indicating apparatus can be placed at any distance from the top of the furnace, as the only connection is electrical, and that by means of a seven-wire cable placed in an iron conduit. The bells are lowered or raised by pressing the desired button shown at the lower part of the illustration.

At the upper part of the indicating device are two glass windows, through which may be seen the indicating card. The central part of this indicating card is red, and shows red when the bell is traversing from one extreme to the other. The upper part of the card is marked "down," and the lower part "up," thus showing through the small windows when the bell is in either of these positions.

Electro-magnets control the movements of the indicator card through the medium of an armature which is attracted toward the electro-magnet, to right or left, as the case may be, when the circuit is closed or opened through the circuit controller. The bell A cannot be lowered unless the bell B is up in place, contact at *b* made, and a complete circuit established through the electro-magnet E. The same is true of the bell B; it cannot be lowered unless the bell A is up in place, and the circuit completed through the contact *a* and operating electro-magnet F. The circuit is open when the arm A is horizontal, and closed when the arm has partly revolved above or below the horizontal position, thereby making contact at points B and C or B and D, whichever is desired.

The operation of the mechanism may be followed by tracing the connections A and B, which refer respectively to bells A and B. If at any time the bell should not be completely hoisted, owing to the hopper not being entirely empty, the indicating device will show red, and the other bell cannot be lowered until the hopper is empty or the obstruction removed. Should necessity demand it, a mechanical device operated from the top of the furnace is provided for hoisting or lowering either bell singly or together. There is a great saving of air in this device over the old way of having an air valve at the bottom of the furnace at the end of a long air pipe; for the pipe and the cylinder had to be filled with air at each operation. The apparatus here described moves the bell very quickly and with little jar.

The time required to lower or raise the bell of a large furnace is about ten or twelve seconds. The power required is insignificant, being but nine watts, or about .00121 horsepower. Current is furnished by four small storage cells, two being used while two are being charged or held in reserve. One set of two cells will operate the apparatus for forty-eight hours. The battery is charged from any source of direct current; in this instance it is supplied from 220 volts direct-current mains through three two-ampere resistance lamps in series. Owing to the small current consumed, a gravity or other form of primary battery can be used.

Three companies have made application for Pennsylvania charters giving them the privilege to construct bridges across the Ohio River from points at Osborne, Leetsdale and Sewickley, Pa., to the opposite side. There are no bridges spanning the Ohio river between the Ohio Connecting Railroad bridge and Rochester. The territory is growing rapidly and there is said to be a demand for the bridges at all of these points. It is estimated that it will cost from $200,000 to $250,000 each to build the bridges.

Graham & Horne and the McKellar Bros., of Fort William, Canada, have disposed of their mining properties on the Atikokan iron range to the Atikokan Mining Co. The mines are to be 140 miles west of Fort William. During the past two years considerable testing of the properties has been going on, and it will take time before any definite work can be done in the developing or shipping.

THE STEAM TURBINE.*

BY FREDERICK A. WALDRON.

The steam turbine which this paper will describe is installed at the works of the Yale & Towne Manufacturing Co., Stamford, Conn., and is the first one of its size (outside of those operated by the builders) to be put into practical operation in this country. After a thorough investigation by the writer, in the early part of 1901, it was decided to install a Westinghouse-Parsons steam turbine for the following reasons: Floor space, economy, continuous operation of existing plant during installation of the new.

The generating outfit consists of a two-phase, 240-volt alternator, of 400 kilowatts capacity (when the turbine was running condensing, and the power factor of the alternator was from 90 to 100 percent), 7,200 alternations, running at 3,600 revolutions per minute, with a separate, direct-connecting exciter set. The alternator is of the revolving field type, and the surface speed of the field is 22,137 feet per minute. The weight of the outfit is 33,200 pounds, and occupies a floor space 19 feet by 4½ feet. The guaranteed economy was 16½ pounds of water per electrical horse-power at the switchboard, with 28 inches of vacuum, 40 degrees Fahr. superheat, and 155 pounds gauge pressure. Tests for economy, under slightly different conditions, show how nearly the guarantee was reached. This opens the question of what is the average ratio between an indicated horse-power at the engine and an electrical horse-power at the switchboard.

The electrical end of the machine is not compounded, and the variation in voltage depends entirely, within certain limits, upon the load and position of rheostats. Speed regulation is very close and perfectly satisfactory. A true kilowatt overload of 33⅓ percent has been carried for five consecutive hours, without apparent injury to the machine. Owing to the low power factor, however, the heat developed in the field and terminals was much higher than is allowable in good practice. When thus overloaded, the voltmeter had to be closely watched, in order to care for any suddenly applied load with the rheostat.

At present, the condenser plant consists of a surface condenser, containing 1,100 square feet of cooling surface, with independent air and circulating pumps. The air-pump is of the simplex, twin beam, vertical type, making about 90 single strokes per minute. The average vacuum obtained with this outfit, with plenty of circulating water, is about 27.4 inches. This outfit is to be replaced by one of more recent design, and operated on the "dry system" and with a two-stage vacuum pump. Steam is furnished by eight Manning boilers. Sixty-four induction motors (with varying loads), ranging from ½ to 40 horsepower, are distributed throughout the works. With the exception of the elevator motors, the entire plant is arranged on the group system. Wherever one or more machines are to be driven, belting or gearing is used, and, if room will permit, belting is given the preference, for the following reasons: (*a*) flexibility; (*b*) less wear and tear on the motors; (*c*) absolute independence of speed of line shafts; (*d*) convenience in case of repairs; (*e*) the advantage of changing, in event of increase or decrease of power requirements; (*f*) equal, if not higher, efficiency under continuous working conditions.

With this arrangement, the power factor will range from 82 to 86 percent, depending on the motor loads. The only precaution to take, in order to prevent frequent shut-downs, with the induction motor, is to have the main circuits fused heavy enough to withstand the influx of current to the line, due to starting.

The iron foundry, which is situated about 700 feet from the power house, requires, from 7 a. m. until 12 m., an average of about 7 horse-power, and from 3 to 5:15 p. m., about 35 horse-power. Building No. 23 (which is an auxiliary to the iron foundry) requires from 25 to 30 horse-power to drive the tumbling barrels and grinders. When the blast is turned on to the cupola, in the afternoon, this motor is shut off, as the help are used in the foundry. The requirements for power in Building No. 25 require 5 horse-power about one-half the time. Box shop (building No. 26) is situated about 1,000 feet from the power house, the nearest line shaft being about 300 feet

*Abstract of paper read at the Saratoga meeting (June, 1903) of the American Society of Mechanical Engineers.

away from it. A 5-horse-power motor is used for about three hours a day at this point. The plating room, fifth floor (building No. 4) uses from 45 to 50 horse-power, five hours per day, and 8 to 10 horse-power for the remaining five hours.

Owing to manufacturing requirements, it is found necessary to run the shafting both lengthwise and crosswise with the building. For example, buildings Nos. 1, 2, 4 and 10 have shafting running in both directions. The electric system of transmission lends itself admirably to this condition. Had this factory been one continuous building of from two to four stories high, with the power house centrally located, shafting ruuuing in one direction, and light machinery installed along its line continuously, the question of the economy of electric transmission would have been doubtful.

The turbine end of this machine has received very little attention in the past year, and has required no renewals or repairs to any of its parts; in fact, from an operating standpoint, it is almost tool-proof. It was found necessary, when assembling the machine, over a year ago, to remove from the bearings, with a fine oil-stone, some burrs which had been thrown up in handling, and also a little rust which had accumulated; upon examination of the same, one year later, these marks had not been worn out, and there was absolutely no difference in the recorded diameters of the bearings, covering a period of one year's wear.

Occasional longitudinal adjustment, to check the clearance between the blades in the case and the revolving element, is necessary. The wear and tear on other parts of the machine have been practically nil, and if the oil is kept in constant circulation and properly cooled, there is no need of a "hot box," and the amount of oil used is extremely small; the consumption of this particular machine being ½ gallon of cylinder oil per week, and from 3 to 5 percent of the lubricating oil on the bearings may be said to be wasted. The quality of the oil used should be perfectly free from acids which would, in any way, tend to injure the bearings. Considerable apprehension has been felt by a great many who have not come in actual contact with the turbine that the blades in the revolving element would be a source of trouble. If the machine is properly set and adjusted, with a chance for expansion between the machine and its condenser, there is (outside of defective material) absolutely no danger from these blades. It is necessary to remove the top of the case of the turbine once in three months (especially when the plant is first started), as red lead or other foreign substances in the pipes are liable to clog the smaller blades, although a steam strainer is provided, which cares for any foreign substances which may in any way injure them.

The principal trouble with the steam end is its liability to shut down, when running from ¾ to full load, because the vacuum is destroyed. This can be prevented, if the engineer is on hand, but sometimes he isn't there, and we have had one or two shut-downs in the last year from this cause. I am informed, however, that a device for automatically preventing this is being designed by the makers, and we expect to have it on our second machine.

It is desirable to place in the pipe for cooling water for the oil well an eel-trap with a by-pass, and, what is still better, if convenient, to have two sources of water supply. An open drip should also be provided, which can be frequently tried by the engineer to insure proper circulation of cooling water. The electrical end of the machine has given us *all* the trouble —not from the result of electrical design and defect, but from mechanical defects, pure and simple.

The field or revolving element is made of four cylindrical forgings, 23⅜ inches in diameter, aggregating in length about 28 inches. These sections are forced on to a shafting, with about 150 tons pressure. Owing to centrifugal force and the heat developed in the field, one of these sections crept on the shaft about ¾ of an inch, the result being that, on the 21st of August, 1902, one of the field wires was pulled apart. Repairs were quickly made and the makers agreed to furnish us a new field, which was placed in position the latter part of December; when, upon starting the machine for the purpose of testing, it immediately (upon attaining full speed, and without any load upon it) flew into a large number of pieces, entirely demolishing the electrical end, and badly damaging the steam end. Investigation showed that invisible flaws in the forging were the cause of this accident. No damage was done to the building, outside of the breaking of a few panes of glass, neither were any of the occupants injured, although there were eight men in the room at the time.

The analysis of the tests would indicate that, with the turbo-generator driving induction motors, and with an evaporation of 8.707 pounds of water, per pound of coal, a brake horse-power can be delivered from the pulley of the motor for about 2½ pounds of coal, with a turbine of this size running under average economy. (This allows 5 percent for banking.)

Under the same evaporative conditions, the average non-condensing engines, distributed through the different rooms in the plant, would require 7.5 pounds of coal per brake horse-power at the fly-wheel, or three times that quantity required for the electrical drive.

As to what would be the actual saving under the existing conditions at this factory, over belt transmission, it would be impossible to calculate, as the conditions which exist at the present are so entirely different from former conditions, owing to the rapid growth of the plant.

What the loss might have been between the engine and pulleys which deliver power to the different rooms, is an unknown quantity. Further, under the conditions which existed at that time, and do exist not, about one-half our steam is utilized for manufacturing purposes and for heating. The question, therefore, of tne comparative total cost of power, is a matter which must be arbitrarily determined, depending on the ratio of the power house charges for power and manufacturing steam. As this is entirely arbitrary, it is not permissible to quote any figures as to the relative costs of power, under the two conditions, as they would be inaccurate and misleading to others. One of the interesting questions answered by the tests is the small amount of power actually used in removing stock, in light manufacturing work.

In conclusion, the results obtained from this outfit may not be any higher than many obtained oy direct connected sets of the same size, running under maximum economical conditions. Assuming, however, that they are the same, the advantages of initial investment, constant economy and the possible extension of the plant with the turbo-generator outfit, are of sufficient importance to warrant the installation. The strongest appeal, however, that the turbo-generator makes to the business man or the engineer is its inherent commercial efficiency. By this, I mean that its efficiency is unchanged week in and week out; year in and year out. Leaky pistons or valves, lack of alignment of slides and bearings, keying up, and, above all, lubrication, all of which exist in the reciprocating engine, are eliminated in the turbine.

Discussion of the Paper.

In the discussion of Mr. Waldron's paper, A. M. Mattice gave the following interesting details of experience:

"My connection with the company which built the turbo-generator described by Mr. Waldron, and which met with an accident at the Yale & Towne works, enables me to lay before the society some facts which may be of interest, particularly to those members who have occasion to use steel forgings for purposes which require great care in the selection of material. The core of this revolving field was a steel forging a trifle less than two feet in diameter. The material was annealed nickel steel, made to specifications which included a requirement of at least 40,000 pounds per square inch elastic limit, and 25 percent enlongation in a standard test piece ½ inch diameter and 2 inches long between gauge points.

"The fact is doubtless familiar to many members that steel forgings frequently show very fine cracks running parallel to the axis of the forging. Sometimes these are superficial, but in other cases are quite deep. I have noticed these cracks more in nickel than in carbon steel. These cracks often show up during rough turning, but the finer ones are frequently developed only by the finishing cuts. We had had occasion to reject several nickel steel forgings for this class of defect previous to the building of the Yale & Towne machine. No defects were discovered at our works, but an examination of the fractured forging showed that there were a number of very deep cracks reaching to several inches below the surface, the difference in appearance between the original cracks and the new fractures being very marked.

"There were no fractures at the points which were sub-

jcted to the greatest stresses due to centrifugal force, but the fractures were extensions of the original cracks; one fracture being at the point where there would have been less stress than at any other point if the metal had been sound.

"An investigation as to why the cracks had not been discovered during the machinaing of the forging in the electric works showed that such cracks may or may not show up during machining, according to circumstances. A crack may not be noticeable to the naked eye, but may be readily traced by a magnifying glass. A crack may not be visible in smooth tool finish, but may be visible to the naked eye or perhaps only by the aid of a magnifying glass after highly polishing. Even after polishing, a crack may not be visible, but will be shown up by etching the surface with diluted nitric acid. Finishing by grinding will hide a crack which a smooth tool finish may expose, presumably because the grinding operation drags the surface of the metal across the crack.

"In examining the surface of a forging for the purpose of discovering possible cracks, care should be taken to discriminate between true cracks and what at first sight might be mistaken for cracks. Sometimes after machining, sometimes after polishing, and sometimes only after etching with acid, sinuous lines will be found, which might be easily mistaken for cracks, but where the metal is perfectly sound. These are what are sometimes called by steel makers 'white streaks.' The cause of these I am unable to explain, but I presume that they are caused by the flow of metal during forging. As far as my experience goes, these streaks appear only near the surface of the rough forging, and disappear at a moderate depth. These streaks may generally be distinguished from cracks by the fact that the streaks are in general wavy and run in various directions, while the cracks are fairly straight and, in general, run nearly parallel to the axis of the forging.

"Test pieces taken from the fractured forging showed a very considerable difference in the quality of the material at the periphery and at the bore for the shaft; the elastic limit being much higher at the bore than at the periphery, and the elongation very much less. Whether this difference has anything to do with the production of surface cracks is a question for steel makers to solve. An analysis of the steel showed considerably higher silicon near the bore than at the periphery, but otherwise the analyses were practically identical.

"The result of an investigation of the cause of the accident cited by Mr. Waldron has convinced us that ordinary methods of inspection and test of steel will not suffice in cases where a fracture might lead to serious results. A test piece, taken from an extension of the forging in the usual manner, may or may not represent the true nature of the forging. This test may show up well, and at the same time the forging may be ductile in one place and very brittle in another.

"In order to guard against a repetition of such an accident, we now require at least two test pieces to be taken from each forging for turbo-generator fields; one from near the periphery and one from near the bore, before preliminary acceptance at the steel works. We also require the surface of the forging to be polished and etched with acid to explore for possible cracks. During the machining operations at the electric works, a number of slots and holes are cut in these forgings to receive the field winding and to provide for ventilation. Advantage is taken of this to obtain further test pieces, thus enabling us to ascertain the true quality of the steel all the way through. The tests made on specimens so obtained have led to a number of rejections of forgings.

"For fear, however, that tests and inspection may fail to locate a defect in the rotor of a turbo-generator, we now test all such generators in our shop at 20 percent over normal speed, thus adding 44 percent to the stresses due to centrifugal force. Where the failure of the governor might cause a reciprocating engine to reach 20 percent over-speed in a comparatively short time, the high ratio between the inertia of the turbo-generator and the driving force causes fluctuations of speed to be very gradual, and a turbine would be so long in reaching over-speed as to give the attendants plenty of time to shut off steam. It may be remarked that the change in the sound due to a change in speed of a turbo-generator, either higher or lower, is so marked that an attendant instantly notices it. The inertia of the turbo-generators will be appreciated by the fact that the 400-kilowatt machines, such as used by Yale & Towne, run for nearly twenty minutes after steam is shut off.

"Mr. Waldron mentions the fact that practically no damage was done to the building or to bystanders by the accident to the generator. This is accounted for by the construction of the stationary armature which is built up of sheet steel punchings, which are lapped over each other, breaking joints, thus forming a structure of such immense strength that the bursting of the rotor running at 3,600 revolutions per minute was insufficient to rupture it.

"Many people would probably lose faith in a comparatively new type of apparatus, like a turbo-generator, after an accident such as the author has described. Mr. Waldron, however, took the matter very philosophically, and seems to have reasoned as follows: The accident was plainly due to flaws in the material and not to fault of design. Similar accidents frequently happen to the flywheels of reciprocating engines. In the case of a turbo-generator, the construction is such that the effects of an accident must be confined within the machine itself, instead of damaging surrounding property. Therefore, aside from other considerations, a turbine outfit is the preferable form of motive power. It is a significant fact that the Yale & Towne Mfg. Co., shortly after the accident, and before the outfit had been repaired, ordered another turbo-generator, which is an exact duplicate of the one to which the accident occurred, thus showing its faith in this type of apparatus."

The Clearfield Steel & Iron Co.

The works of the Clearfield Steel & Iron Co., a corporation chartered under the laws of Pennsylvania, were formally turned over, in the past week, to the officers of the company by Hyde Bros. & Co., of Pittsburg, who designed, built and put them in operation. The plant is of modern design and well equipped for the production of high grade muck bar, chain iron, bolt and rivet iron, skelp and light iron and steel rails for lumber and mining purposes. The buildings, which are of steel, cover a floor space of over 73,000 square feet, the main building being 34 feet high and equipped with a 15-ton electric traveling crane for changing rolls, etc. Practically all the steam power required is derived from the waste heat of puddling and heating furnaces, there being nine waste heat boilers aggregating 1,200 horsepower attached to different furnaces. The company has its own coal mines, of low sulphur coal, within half a mile of the plant, and is well situated on the banks of the Susquehanna river for an ample supply of pure water.

The works are situated on the line of the B. R. & P. Ry. about two miles from Clearfield, Pa., and have switching arrangements to the Pennsylvania Railroad and the New York Central. The capacity of the plant, when running full, will be about 50,000 tons a year of iron and steel. The capital stock is $750,000 all of which is subscribed for with the exception of a small amount of treasury stock, and the list of stockholders includes some of the leading bankers and business men of Pittsburg, New York, Rochester and Clearfield. The Pittsburg offices of the company are in the German National Bank Building, Wood St. and Sixth Ave.

The eighteenth annual outing of the employes of the Jeffrey Mfg. Co., which was held at Olentangy Park, Columbus, Saturday, June 27, was one of the most delightful and successful in the history of the company. Many of the employes attended the theater on the grounds, to which admission was free, and there were numerous other attractions.

The Zier Boiler & Sheet Iron Co. has been organized at New Albany, N. Y., with a capital of $25,000. The board of directors for the first year will be Postmaster Robert W. Morris, Michael Zier, Peter Young, William Miller and Frances Zier. Mr. Morris will be president. The company is a reorganization of the Zier Boiler Co., which made an assignment some months ago.

The Wing-Sayle Foundry & Machine Co., of Little Rock, Ark., failed a few days ago with liabilities $17,000, assets $10,000.

Machine Cast Pig Iron for the Foundry.*

BY EDGAR S. COOK, POTTSTOWN, PA.

The blast furnaces now in operation represent all sorts and conditions as referred to shapes, sizes and equipment. The tendency for some years past, however, has been to eliminate the smaller stacks of an earlier generation, so that fewer furnaces are producing a vastly increased product as compared with the statistics of only 10 years ago. The modern blast furnace, with its daily product of 400 to 600 tons of pig iron, has been of gradual growth, and become a possibility only through the accumulated experiences of intelligent and educated managers, capable of applying the teachings of science, and at the same time thoroughly trained by a severe apprenticeship in the practical every-day routine of actual working. More intelligent management rendered evident the necessity of stronger equipment and larger furnaces to insure economies, and the latter in turn called for improved mechanical appliances to handle in a limited time the large tonnages of raw materials necessary to keep the furnaces in continuous operation.

The casting machine, for handling the iron product, followed as a natural consequence, more, however, to overcome the labor problem of moving the iron from the cast house than for any other reason. The machine cast iron gives promise of solving, or at least helping to solve, the difficulties that have always attended the sampling of pig iron, especially the foundry grades. The casting machine may prove an unexpected benefit in removing "a bone of contention" between consumer and maker, and enable the foundry to receive a more reliably uniform iron, pig for pig, than is possible under sand-bed conditions.

From the conditions surrounding the production of pig iron, as well as the constitution of cast iron itself, variations in composition are unavoidable. So many causes come in to affect the working of the blast furnace, all of which show on the iron, to say nothing of the variations in the raw materials used, that the only wonder is that the product of the blast furnace does not show wider ranges or fluctuations and that the composition is under the control that has been found possible by careful management. Notwithstanding the most careful attention on the part of the manager, one cast will differ from another in composition, and individual beds of the same cast will differ. Within only comparatively recent years, the furnaces have been able, with the help of well-equipped laboratories, to select different casts, to suit the specifications of customers, or their assumed requirements, based upon experience, in the absence of specified analysis.

The Coming in of Analysis.

Indications all point to the substitution of analysis for the old-time method of grading by fracture. Commencing with the larger users, and the makers of specialties, requiring more positive information as to the composition than was afforded by the fracture, the use of pig iron guided by analysis has spread with much greater rapidity to all classes of foundry work than the most sanguine expected.

Grading by fracture, as guided by experience with any particular brand of iron, has some points in its favor, else it would have been supplanted earlier. The fact that for so many years castings of multitudinous forms, and for an endless variety of uses, were made in a fairly satisfactory manner by skilful guessing as to mixtures, only goes to demonstrate that for many classes of work there is a very considerable range in composition allowable without injuriously affecting the castings. With accurate knowledge as to requirements and more positive information as to the composition of pig iron there will doubtless be a smaller percentage of loss of defective castings. The castings themselves will be better adapted for the purpose designed, and the causes of defective work can be more definitely located.

It might just as well be borne in mind, that working by analysis will not prove a panacea for all the ills to which foundry practice is subject. It will occur to every practical man that there are many causes entering into the success or failure of foundry practice, other than the composition of the pig iron placed at the mouth of the cupola.

There are limitations also to the ability of blast furnaces to furnish the raw pig, within too narrow limits as pertaining to any particular set of specifications, without unduly enhancing the cost. In the long run the consumer must pay the cost and risks of manufacture, plus a fair profit on the capital invested, otherwise the supply will not equal the demand. There are special irons that must be of certain composition and must not vary, except within very narrow limits. The manufacture of these demands special ores and special fuels, as well as most careful scrutiny as to the uniformity. The ores and fuels, etc., suited are not in abundant supply, and therefore command high prices comparatively. The unavoidable "misfits" made by the furnace, and sold at less than cost, enhance the average cost of manufacture, for all of which the consumer must ultimately pay.

Blast furnaces could be run with much more comfort to the manager and with much better average result in every way, were it possible to obtain absolutely uniform raw material—ores, fuel and limestone. It would also be a great gain if the atmospheric air driven into the tuyeres always contained the same weight of oxygen per cubic foot of air, and the same weight of moisture. If all the furnaces operating today demanded ores absolutely uniform in composition, that is, the product of any one mine, to run always the same in percentage of iron and gangue, and that the coke should not vary in sulphur, phosphorus, ash and fixed carbon, the greater portion of the furnaces would be obliged to discontinue operations and the cost of pig iron would rise to prohibitory figures.

Since chemistry has unfolded the secrets of Nature's storehouses of raw material, the uniform ore deposit of coal and of limestone is about as scarce as the perfectly developed man or woman. The furnaces are obliged to take ores, etc., as they find them and by judicious mixing, based upon an approximate knowledge of their contents, endeavor to produce as uniform a product as possible.

This product is the raw material of the foundry, rolling mill, steel works, etc. It is a wise precaution, therefore, in substituting the new system of grading by analysis for that of fracture, not to draw the lines any closer nor make the conditions any more severe, than is absolutely necessary to meet the requirements of any particular class of manufacture. I have seen certain crude specifications for pig iron, probably formulated by a young chemist, fresh from the technical college, but without any metallurgical training, so rigid and exacting with regard to carbons, silicon and sulphur, phosphorus, manganese, etc., that probably not one cast in a thousand from any one furnace would meet all the conditions imposed.

Reference has been made to the variable composition of pig iron, as referred to sand cast pig, cast in the usual way. Different portions of the same pig will show varying percentages of silicon and sulphur. Different pigs of the same bed will vary one from another, and different beds of the same cast will frequently show wide variations. It is not worth while to here attempt an explanation of the causes, but merely accept the fact as an unavoidable feature of blast furnace conditions, as existing at most of the plants engaged in the merchant business.

The blast furnace may be said to be in the "half-civilized" stage, having preceded our foundry friends in emerging from the "barbaric" stage by nearly a score of years. The foundry is really most interested in knowing the exact composition of its raw material, pig iron. This is more important than having it rigidly conform to any particular set of specifications defining the limits of silicon, sulphur, etc. Knowing the composition of his raw material, pig iron, it remains for the foundry superintendent to employ the scientific method and make a mixture of various brands of varying composition, if

*From a paper read at the Delaware Water Gap meeting (July, 1903) of the American Society for Testing Materials. Mr. Cook prepared a paper for the Foundrymen's Association in May, 1899, on machine cast pig iron for foundry use, and it appeared in *The Iron Trade Review* of May 11, 1899. The present paper, of which the full title is, "Machine Cast Sandless Pig Iron in Relation to the Standardizing of Pig Iron for Foundry Purposes," is supplementary to the earlier one.

unable to obtain one iron to meet all the requirements, in order to produce the result he started to make.

Greater Uniformity with Sandless Pig Iron.

The sandless pig, made in the casting machine, gives promise of attaining the desirable uniformity more effectively than can ever be reasonably expected from sand cast pig. In the direct process from blast furnace to the Bessemer converter and steel ingot, the mixer was found indispensable to insure uniform products and a minimum percentage of defective ingots.

The correct sampling of sand cast pig is troublesome and expensive. This is especially true of the foundry grades. In order to obtain a fairly representative sample, numerous pigs must be taken and drilled with care. Even then different samplings of the same lot of iron will show frequently widely varying results as to silicon and sulphur, notwithstanding that the same method of analysis may be used. This brings about misunderstandings quite as difficult to adjust as the disagreements with respect to the fracture any particular grade should show.

I do not refer to differences that are brought about for commercial reasons, as affecting the price, where judgment is warped by money considerations. I have in mind several experiences of our own, illustrating the difficulty of arriving at the composition of sand cast pig when the question of price did not enter into the matter at all, as no particular guarantees had been made. The purchaser required reasonably accurate information to guide him in using the iron, and we cooperated with him in sampling and making analyses, the results being compared. All of the samples selected by us were made by drilling about one dozen pigs to represent each lot of 50 tons:

Purchaser's Sampling and Analysis.		Warwick Iron & Steel Co.'s Sampling and Analysis.	
Silicon.	Sulphur.	Silicon.	Sulphur.
1.90	trace	0.964	0.045
1.23	0.04	0.926	0.045
0.85	0.09	0.855	0.050
1.71	0.035	0.880	0.040
1.08	0.040	0.910	0.060
1.03	0.06	1.010	0.080
1.04	0.05	1.08	0.050
1.31	0.04	1.19	0.04
1.50	0.03	1.09	0.06
0.62	0.05	0.74	0.04
0.87	0.03	0.80	0.04
1.21	0.04	0.92	0.07
1.04	0.05	1.08	0.05

The marked discrepancies in silicon were found to be due to particles of sand getting into samples through lack of care in handling, while drilling the sand coated pigs in the machine shop of purchaser. The iron sold was all of the gray forge grade.

Sampling from Liquid Iron.

This experience led us to adopt the method of sampling iron liquid, as it ran from the furnace, which plan was in use by the Western furnaces connected with steel works. It has been found more reliable, as fairly representing iron as it will be used in quantity, than the drilling of several pigs. At times certain casts run remarkably uniform as to silicon and sulphur, the differences existing between the different beds not being more than can be accounted for in laboratory work, but this is the exception rather than the rule. Phosphorus is generally evenly distributed. Segregation does not seem to affect it, and there is seldom any difficulty in determining the contents. The following will illustrate the variation of sand cast iron, one pig being selected from the middle of every alternate bed:

BEDS.	Open Gray Forge A.		No. 2 Strong B.		Soft Foundry C.		D.	
	Silicon.	Sulphur.	Silicon.	Sulphur.	Silicon.	Sulphur.	Silicon.	Sulphur.
2	1.481	0.068	1.609	0.013	2.52	0.011	2.52	0.014
4	1.434	0.066	1.575	0.009	2.60	0.015	2.56	0.013
6	1.468	0.074	1.599	0.009	2.66	0.013	2.58	0.013
8	1.481	0.066	1.599	0.003	2.80	0.013	2.53	0.012
10	1.456	0.056	1.622	0.009	2.92	0.013	2.55	0.012
12	1.411	0.060	1.575	0.011	3.01	0.011	2.56	0.013
14	1.292	0.066	1.528	0.011	2.92	0.011	2.48	0.013
16	1.198	0.056	1.528	0.006	3.04	0.014	2.84	0.013
18	1.222	0.055	1.411	0.011	.....	.....	.....	.....
20	1.222	0.048	1.363	0.008	.....	.....	.....	.....

CAST ANALYSIS, LIQUID SAMPLES.

	1.363	0.054	1.599	0.012	2.60 2.23	0.011 0.013	2.50 2.88	0.013 0.015

Cast A. The silicon varies between 1.481 and 1.222 and the sulphur between 0.074 and 0.048.

Cast B. The silicon varies between 1.669 and 1.363 while the sulphur happens to be exceptionally low.

Cast C. Shows a wide variation in silicon, 3.01 to 2.04, while the sulphur is very low and constant.

Cast D. Represents a uniform cast both in silicon and sulphur.

All of the casts were taken at random, sampled and analyzed. Another series might be more variable in silicon and sulphur, depending upon furnace conditions.

Following are examples from different portions of the same cast of sand pig:

Grade.	First Sample.		Second Sample.	
	Si.	S.	Si.	S.
No. 2x	2.23	0.017	2.45	0.015
"	3.29	0.014	2.30	0.031
"	2.16	0.033	1.46	0.018
"	2.15	0.036	2.40	0.027
"	3.24	0.035	2.16	0.060
"	3.20	0.026	3.32	0.017
"	3.21	0.051	3.17	0.036
No. 2	1.62	0 075	2.58	0.033
"	1.88	0.035	2.66	0.013
No. 3	1.25	0.035	0.89	0.050

SAND IRON.

Liquid samples: Cast Analysis.
Silicon, 2.20 Sulphur, 0.021
" 2.85 " 0.017

	Si.	S.
Pig from 1st bed	1.99	0.026 0.022
Pig from 3rd bed	2.17	0.022
Pig from 5th bed	2.29	0.024
Pig from 7th bed	2.46	0.024
Pig from 9th bed	2.57	0.027
Pig from 11th bed	2.60	0.023
Pig from 13th bed	2.66	0.022
Pig from 15th bed	2.85	0.020
Pig from 17th bed	2.36	0.019
Pig from 19th bed	1.80	0.021 0.021

This cast shows considerable variation in silicon, while the sulphur is uniform.

Where the iron represented by one analysis ends and the other begins, it is a difficult matter to determine. Occasionally physical indications serve as a guide to the experienced grader.

These illustrations show the difficulties besetting the accurate or scientific determination of the composition of sand cast pig, even when all parties interested are actuated by the best of intentions. When the situation is complicated by mercenary considerations, it can be easily surmised that grading by analysis may not be the great boon expected in removing all friction. It is an improvement upon grading by fracture, and certainly a safer guide as to the use of all pig iron. It is fortunate, however, that for most classes of foundry work the variations in carefully selected foundry irons are not fatal, due to the range in composition of castings that practice has proven to be permissible.

In 1892 Dr. R. W. Raymond said: "Even if all pig iron should come to be cast in chills, which would be a very good thing, I have no doubt the grain would still be found legible as an inscription of quality, though the handwriting would be finer and the language a new one."

This we have found to be especially true of machine cast sandless iron. The process of handling the molten iron from the furnace to the pig, as shipped, changes the physical appearance of the fractured surface so radically, that entire dependence must be placed upon the analysis, until such time as the new language has been learned.

I have been agreeably surprised at the aptitude shown by foundry consumers generally, and especially those not working by technical rules, in comprehending the novel appearance of machine cast sandless iron—so different from the standards previously considered essential. Careful investigations indicate that if the chemical composition is as desired for any particular work, the physical appearance can be entirely neg-

lected, without any risk whatever. What the mixer is for the Bessemer steel works, the 20-ton ladle cars are for sandless foundry iron.

The molten iron, running into the ladle from furnace, becomes thoroughly mixed, and the pouring from ladle in a smaller stream into the moving metallic molds should bring about a more complete mixing, so that the composition of individual pigs, taken at random from the first pouring of ladle, and last portion, ought to show insignificant variations, and compare closely with one another.

Analysis of Machine Cast Foundry Iron.

The analyses of machine cast sandles foundry iron would indicate that the expectations are being realized:

	Si.	S.
Cast E, one ladle.		
Pig from first pouring	3.01	0.015
Pig from middle pouring	3.00	0.009
Pig from last pouring	3.10	0.010
Average liquid sample	3.05	0.010
Cast F, two ladles.		
1st ladle, pig from first half	1.97	0.022
Pig from second half	1.97	0.022
Average liquid sample	1.82	0.019
2nd ladle, pig from first half	2.08	0.020
Pig from second half	2.04	0.020
Average liquid sample	2.22	0.015
Cast G, two ladles.		
1st ladle, pig from first half	2.30	0.011
Pig from second half	2.29	0.011
Average liquid sample	2.30	0.025
2nd ladle, pig from first half	2.43	0.010
Pig from second half	2.41	0.012
Average liquid sample	2.51	0.031
Cast H, two ladles.		
1st ladle, pig from first half	2.07	0.021
Pig from second half	1.97	0.021
Average liquid sample	1.72	0.023
2nd ladle, pig from first half	2.10	0.027
Pig from second half	2.10	0.025
Average liquid sample	2.50	0.014
Cast K, two ladles.		
1st ladle, pig from first half	2.17	0.014
Pig from second half	2.18	0.017
Average liquid sample	1.96	0.013
2nd ladle, pig from first half	2.34	0.021
Pig from second half	2.39	0.018
Average liquid sample	2.40	0.013
Cast L, two ladles.		
1st ladle, pig from first half	2.17	0.049
Pig from second half	2.18	0.047
Average liquid sample	2.24	0.041
2nd ladle, pig from first half	2.09	0.042
Pig from second half	2.13	0.042
Average liquid sample	2.19	0.031
Cast M, two ladles.		
1st ladle, pig from first half	2.11	0.018
Pig from second half	2.08	0.016
Average liquid sample	2.04	0.021
2nd ladle, pig from first half	2.32	0.017
Pig from second half	2.11	0.016
Average liquid sample	2.35	0.021
Cast N, two ladles.		
1st ladle, pig from first half	1.99	0.027
Pig from second half	1.94	0.026
Average liquid sample	1.77	0.031
2nd ladle pig from first half	2.12	0.028
Pig from second half	2.14	0.030
Average liquid sample	2.22	0.028
Cast O, two ladles.		
1st ladle, pig from first half	2.17	0.014
Pig from second half	2.15	0.013
Average liquid sample	2.20	0.014
2nd ladle, pig from first half	2.21	0.014
Pig from second half	2.16	0.013
Average liquid sample	2.30	0.020
Cast P, two ladles.		
1st ladle, pig from first half	2.39	0.013
Pig from second half	2.17	0.013
Average liquid sample	2.15	0.009
2nd ladle, pig from first half	2.43	0.014
Pig from second half	2.47	0.015
Average liquid sample	2.98	0.012
Cast R, two ladles.		
1st ladle, pig from first half	2.49	0.012
Pig from second half	2.50	0.010
Average liquid sample	2.50	0.013
2nd ladle, pig from first half	2.50	0.012
Pig from second half	2.49	0.015
Average liquid sample	2.28	0.013

It will be observed that as a rule, there is a close correspondence in the analysis of pigs taken hap-hazard from different parts of the same ladle, and of the liquid sample of the ladle. Also that the average of these analyses, for the entire cast, do not differ materially from the average of the analyses of the liquid samples, representing the same cast. The exceptions are less than might be expected, and may be regarded in the light of "exceptions proving the rule."

Cast P was evidently a variable cast, somewhat similar to sand cast C. If the Cast P had been run into sand beds, some of the beds would have been filled with a 2.15 percent silicon iron, and others with 2.98 percent silicon, and intervening beds with silicons between the two extremes. By mixing in the ladles, this wide variation is in a great measure corrected, the iron of each ladle being reasonably uniform.

Referring to Cast R, the pig samples of the first ladle, and the liquid sample are practically identical. The pig samples of the second ladle, compare with one another, and with those of the first ladle, but differ from the liquid sample, supposed to represent the contents of second ladle. In this instance, the man taking liquid sample evidently forgot himself, or for some reason, neglected to dip his sample from the running stream, until the end of the cast, or when the ladle was nearly full. The quantity of 2.28 percent silicon was too small to affect the average of ladle, as shown by the analyses of the pigs.

The liquid samples are taken by a laborer, without the exercise of any judgment whatever, except to obey general directions, that several samples shall be taken to represent each ladle, viz.: from the first, middle and last run of iron of each ladle. Some better plan may be developed, but it is probably as trustworthy as any method that can be devised, to suit blast furnace conditions.

Experience with Machine Cast Iron.

With but few exceptions our machine cast sandless foundry iron has met with unqualified approval. When anything goes wrong with any particular heat in the foundry, it is only human nature that the responsibility should be placed upon the new brand of iron used in cupola mixture. If this happens to be sandless iron, differing greatly in physical appearance from recognized standards of long standing, it is only natural that the sandless iron should be held responsible. Several instances of this kind have occurred. The investigations following have not only served to remove censure and prejudice, but at the same time, to demonstrate the unusal uniformity of sandless iron, pig for pig.

Customers have been requested to select and forward pieces representing from their views, the worst looking pieces physically, to be found in the car. By the "worst looking," I refer to pigs that show a porous or spongy structure, in consequence of the molten iron boiling, when poured into a damp or cold mold. This boiling destroys the grain, and the appearance is such as to warrant misgivings on the part of the inexperienced user. So far as our investigations have gone, and based also upon the experience of those using the iron, the solid pigs, whether close or open in fracture, and the porous pigs from one ladle, show the same composition, and compare closely with the average liquid sampling of ladles. When re-melted in cupola, the results are the same.

The following analyses are given, to illustrate:

	Si.	S.
Ladle analysis	1.86	0.028
Solid pig from car	2.00	0.027
Porous pig from car	2.10	0.028
Ladle analysis	2.03	0.021
Porous pig	2.05	0.025
Cast average	2.25	0.02
First ladle	2.35	0.017
Second ladle	2.12	0.021
One pig from car (solid fracture)	2.32	0.014
One pig from car (porous fracture)	2.11	0.016

Borings from individual pigs, at random from car:

Sample 1	2.10	0.023
Sample 2	2.17	0.016
Sample 3	2.09	0.016
Sample 4	2.10	0.012
Sample 5	2.13	0.015
Sample 6	2.10	0.013

The data so far collected go to show that the casting machine is the agent, by which practical uniformity, with a reasonable allowance for the human fallibility of employes, can be obtained in the composition of any particular cast, one

pig compared with another, and will insure greater uniformity in the raw material of the foundry. It remains for the furnace to select the casts that fall within the specifications of any particular customer, as to silicon, sulphur, etc.

The physical appearance of machine cast sandless iron is influenced by several conditions, which have no effect upon the quality, as determined by chemical composition. The casting temperature from tapping hole of blast furnace, together with rapid or slow running into ladle car; the pouring temperature from ladle into molds; the temperature of molds, whether cold, warm or hot, the generation of gas from water of hydration in the lime coating of mold, causing agitation of the molten iron and more or less boiling.

The casting machine is formed of two parallel strands of molds. The speed or rate of movement can be regulated within certain limits. Usually the speed is such that any pair of molds are 15 to 20 minutes in moving from the pouring end to the discharge end, distant 90 feet. In this time the liquid iron poured into the mold sets or freezes, forming a skin or shell. This shell is strong enough to carry weight of pig, when discharged upon plates of conveyor. The interior, however, is in a liquid or semi-liquid condition.

When the molds are thoroughly heated, from having been filled the second and third time, without opportunity to cool, the shell forming exterior of pig is not strong enough to carry weight. It cracks when dropped on the conveyor and "bleeds." The pig will thus become hollow. This necessitates a temporary stoppage of the casting machine to allow time for the setting of the metal. In the highly heated condition, the pigs are carried by conveyor into a bath of water. The pigs are submerged for 8 to 10 minutes, and rapid cooling sets up internal strains so violent that upon emerging from the water bath, many of the pigs break into halves or quarters, etc., depending in a great measure upon the silicon contents. Sometimes with low-silicon pig—below 0.50 percent—the strains are so violent that large pieces are thrown out of the conveyor, jumping three of four feet, with a report like the discharge of a pistol. I presume the same effect would be noticed in iron containing high percentage of silicon, say 4 percent or over.

Advantages Chiefly for the Foundry.

The advantages of sandless iron, accrue chiefly to the foundry. The benefit to the furnace is found solely in relieving the management from the labor troubles, incident to securing men to break hot iron in the pig beds, and remove from beds in the limited time necessary. As an economical proposition, our experience of a year or more would show that there is no saving of expense, but rather the reverse. The cost of labor and of maintenance of the casting machine is in excess of the human machine. In addition, the yield of ore mixture in iron is less, when the shipments are of sandless iron, as compared with sand casting, thus showing that notwithstanding the usual allowance for sand the customer receives more pounds of iron per ton of sandless pig than of sand cast. This fact, together with greater ease of melting in cupola (the sand covering being more infusible than iron) and the greater uniformity of casting machine sandless iron, will explain why it has met with such general favor.

Referring to the infusibility of the sand coating of pig iron, I am informed by a very observant manager of a puddle mill, that he has frequently noticed in the hearth of a puddle furnace, that the iron melts, leaving the empty silicious shell standing in the bath of liquid metal. This is broken down by the workman, and is then liquefied. My attention has also been called to the fact that similar shells are occasionally found in the debris, upon the dropping of the bottom of a cupola. Several years ago, a foundry superintendent, who had noticed the silicious coating, when the bottom of his cupola was dropped, asked me if we could not furnish pig with all metallic surfaces. He argued that as the iron melted, and the sand coating at the same temperature did not, the latter was an injury in the way of requiring a larger quantity of fuel, than would otherwise have been found necessary. He was agreeably surprised, when told that in the course of a few months, we would be able to supply him with pig iron entirely free from sand.

Almost without exceptions, those who have given casting machine sandless iron a fair trial, request continued supplies in preference to sand cast. Distinction is to be made between machine cast sandless, and the sandless pig made in chill molds. While the latter shares with the former all the advantages due to absence of sand coating, it is lacking in the more important element of uniformity, pig for pig. The beds of chill molds simply replace the beds of sand, and are filled in the same way—one bed after another, as the metal is run direct from the furnace, without the intervention of a "mixer," in the shape of a large ladle car, and the further intimate mixture, consequent upon pouring from ladle into molds.

Iron and Steel Production in the United States in 1902.

From advance sheets of the annual statistical report of James M. Swank, general manager of the American Iron and Steel Association, we are enabled to present below a full summary of the production of iron and steel in various forms in the United States last year. The report, from which some advance tables have appeared in the *Bulletin* of the association in recent months, these being reprinted in our columns, is up to the standard of excellence long maintained by the association's statistical publications. The report for 1901 introduced somewhat more detail than its predecessors, particularly as to the various descriptions of pig iron. This fullness of detail also characterizes the report for 1902. The table below gives a summary of the statistics for 1902 in comparison with those for 1901:

SUMMARY OF STATISTICS FOR 1901 AND 1902.

Subjects.	1901.	1902.
Production of Pig Iron, gross tons	15,878,354	17,821,307
Production of Spiegeleisen and Ferro-manganese, included in Pig Iron, gross tons	291,461	212,981
Production of Iron and Steel Structural Shapes, gross tons	1,013,150	1,300,326
Production of Iron and Steel Wire Rods, gross tons	1,365,934	1,574,293
Production of Plate and Sheet Iron and Steel, except Nail Plate, gross tons	2,254,425	2,665,409
Production of Iron and Steel Cut Nails and Cut Spikes, kegs of 100 pounds	1,542,240	1,633,762
Production of Iron and Steel Wire Nails, kegs of 100 pounds	9,803,822	10,982,246
Production of Bar, Bolt, Hoop, Skelp, Rolled Axles, Rolled Armor Plate, etc., gross tons	4,772,329	5,383,219
Production of all Rolled Iron and Steel, including Cut Nails and excluding Rails, gross tons	9,474,688	10,996,183
Production of all Rolled Iron and Steel, including both Cut Nails and Rails, gross tons	12,349,327	13,944,116
Production of Bessemer Steel Rails, gross tons	2,870,816	2,935,392
Production of Open-hearth Steel Rails, gross tons	2,093	6,029
Production of Iron Rails, gross tons	1,730	6,512
Production of all kinds of Rails, gross tons	2,874,639	2,947,933
Production of Bessemer Steel, gross tons	8,713,302	9,138,363
Production of Open-hearth Steel, gross tons	4,656,309	5,687,729
Production of Crucible Steel, gross tons	98,513	112,772
Production of Blister and Patented Steel, gross tons	5,471	8,386
Production of all kinds of Steel, gross tons	13,473,595	14,947,250
Production of Open-hearth Steel Castings, gross tons	301,622	367,879
Production of all kinds of Steel Castings, gross tons	317,570	390,935
Production of Ore, Pig, and Scrap Blooms for sale, gross tons	10,547	12,002
Production of Tinplates and Terne Plates, gross tons	399,291	366,000
Value of Imports of Iron and Steel	$20,395,015	$41,468,826
Value of Exports of Iron and Steel	$102,534,575	$97,892,036
Production of Iron Ore, gross tons	28,887,479	.....
Imports of Iron Ore, gross tons	966,950	1,165,470
Production of all kinds of Coal, gross tons	261,873,675	.....
Production of Coke, net tons	21,795,883	.....
Production of Pennsylvania Anthracite, gross tons	60,242,560	.....
Shipments of Pennsylvania Anthracite, gross tons	53,568,601	31,200,890
Imports of Coal, gross tons	1,920,248	2,551,381
Exports of Coal, gross tons	7,383,393	6,126,946
Miles of New Railroad built (estimate for 1902)	4,906	6,000
Immigrants in the year ended December 31	522,573	739,289

Pig Iron Production and Consumption.

The pig iron production in 1902, as already published, was 17,821,307 gross tons, as against 15,878,354 tons in 1901. The table below gives the production by grades in 1901 and 1902.

The Bessemer figures for 1901 and 1902 include low-phosphorus pig iron. The basic figures do not include the small quantity of basic pig iron that is made with charcoal, practically all of which is used in the manufacture of steel castings. High silicon pig iron is included in the foundry figures:

Grades—Gross tons.	1901.	1902.
Bessemer and low-phosphorus pig iron	9,596,793	10,393,108
Basic pig iron made with mineral fuel..	1,448,850	2,038,590
Forge pig iron	639,454	833,093
Foundry pig iron	3,548,718	3,851,276
Malleable Bessemer pig iron.....	256,532	311,458
White and mottled and miscellaneous grades	87,964	172,085
Spiegeleisen	231,822	168,408
Ferro-manganese	59,639	44,573
Direct castings	8,582	8,656
Total	15,878,354	17,821,307

Of the total production of pig iron in 1902 over 58 percent was Bessemer and low-phosphorus, as compared with over 60 percent in 1901; 21.6 percent was foundry, against 22.3 percent in 1901; over 11 percent was basic, against 9 percent in 1901; 4.6 percent was forge, against over 4 percent in 1901; 1.19 percent was spiegeleisen and ferro-manganese, against 1.8 percent in 1901; and 1.7 percent was malleable Bessemer, against 1.6 percent in 1901. The production of white and mottled and of miscellaneous grades of pig iron amounted to less than 1 percent in both years. Castings made direct from the furnace did not amount to one-tenth of one percent in either year. In 1902 the production of low-phosphorus pig iron, which is chiefly used by manufacturers of acid open-hearth steel, was for the first time definitely ascertained. It amounted to 164,246 gross tons, and was made by four States, namely, New York, New Jersey, Pennsylvania, and Tennessee.

The consumption of pig iron in 1902 is approximated by adding together the domestic production, the imports and the stocks unsold on Jan. 1 and subtracting the unsold stocks Dec. 31 and the exports. The imports were 625,383 tons the unsold stocks Jan. 1, 73,647 tons. The stocks on Dec. 31 were 49,951 tons, and the exports were 27,487 tons. The approximate consumption is thus put at 18,442,899 tons, against 16,232,446 tons in 1901, 13,177,409 tons in 1900 and 13,779,442 tons in 1899.

Production of Ferro-Manganese and Spiegeleisen.

Below are given the statistics of the imports of ferro-manganese, spiegeleisen, and ferro-silicon which were entered for consumption in the calendar years 1900, 1901 and 1902:

Articles.	1900		1901		1902	
	Gross tons	Values	Gross tons	Values	Gross tons	Values
Ferro-manganese.....	8,122	$467,592	20,751	$870,828	40,386	$1,818,036
Spiegeleisen.....	14,184	619,949	26,827	677,246	62,813	1,473,853
Ferro-silicon	2,165	81,442	822	21,224	15,945	362,110

Production of Steel.

The production of Bessemer steel ingots and castings in 1902 was 9,138,363 gross tons; of basic open-hearth steel, 4,496,533 tons, and of acid open-hearth steel, 1,191,196 tons. The production of all kinds of steel ingots and castings by States in 1902 is given in the following table, in gross tons. Of the total production 390,935 tons were direct steel castings. The increase in the production of all kinds of steel in 1902 as compared with 1901 was 1,473,655 tons, or 10.9 percent.

States—Gross Tons.	Bessemer.	Open-hearth.	Crucible and miscellaneous.	Total Ingots and Castings.
Mass., Rhode Island and Conn	.....	179,923	2,105	182,028
New York and New Jersey	2,082	92,763	25,430	120,275
Pennsylvania.....	4,299,326	4,375,384	88,866	8,673,556
Del., Md., W. Va., Ky., Tenn. and Ala.....	743,042	252,041	20	995,103
Ohio.....	2,528,802	278,854	125	2,807,781
Indiana and Illinois.....	1,443,614	476,514	2,865	1,922,993
Mich., Wis., Minn., Mo., Col. and Cal.....	211,497	32,270	1,747	245,514
Total.....	9,138,363	5,687,729	121,158	14,947,250

Production of All Kinds of Steel Castings.

In 1902 the production of all kinds of steel castings amounted to 390,935 gross tons, against 317,570 tons in 1901, 192,803 tons in 1900, and 181,112 tons in 1899. The increase in 1902 over 1901 was 73,365 tons, or over 23 percent, but over 1899 it was 209,823 tons, or over 115 percent. The following table gives by States the production of Bessemer, open-hearth, crucible, and other steel castings in 1902, in gross tons.

States—Gross tons	Bessemer	Open-hearth	Crucible and miscellaneous	Total Gross tons
s., Conn., New York & N. J.	2,082	37,041	6,138	*45,261
Pennsylvania.	1,270	152,399	1,293	154,962
Tennessee, Alabama, and Ohio	1,000	33,617	75	34,692
Indiana, Illinois, and Michigan	6,078	117,552	1,265	124,895
Wis., Minn., Mo., Col., and Cal.	2,118	27,270	1,747	31,135
Total..	12,548	367,879	10,508	390,935

Of the total production of steel castings in 1902 Pennsylvania made over 39 percent, against almost 35 percent in 1901; Illinois over 25 percent, against over 32 percent in 1901; Ohio over 8 percent in each year; and Indiana almost 6 percent, against over 4 percent in 1901. No other State made over 5.2 percent in either year.

Production of All Kinds of Rails.

The production of all kinds of Bessemer steel rails by the producers of Bessemer steel ingots in 1902 was 2,876,293 gross tons, against a similar production in 1901 of 2,836,273 tons, in 1900 of 2,361,921 tons, and in 1899 of 2,240,767 tons. The maximum production of Bessemer steel rails by the producers of Bessemer steel ingots was reached in 1902, but the increase in that year over 1901 amounted to only 40,020 tons, or 1.4 percent. As compared with 1887, fifteen years ago, the increase in 1902 in the production of Bessemer rails amounted to only 831,474 tons, or 40 percent, while during the same period the increase in the production of Bessemer ingots amounted to 6,202,330 tons, or almost 211 perecnt. The following table shows the production by States of Bessemer steel rails by the producers of Bessemer steel ingots in the last six years, not including a small quantity of rails made each year from purchased blooms or from rerolled steel rails:

States—Gross tons.	1897	1898	1899	1900	1901	1902
Pennsylvania..	1,024,386	1,052,771	1,224,807	1,195,255	1,406,008	1,148,425
Other States...	590,013	902,656	1,015,960	1,166,666	1,430,265	1,727,868
Total.....	1,614,399	1,955,427	2,240,767	2,361,921	2,836,273	2,876,293

With the exception of the Lackawanna plant at Scranton, which was dismantled in 1902, all our Bessemer rail mills were operated nearly to their full capacity in that year, the demand for steel rails being greater than the supply all through the year. Some interruption to the utmost possible activity of the Bessemer rail mills in 1902 was also caused by the inability of the railroads to promptly deliver raw materials to the blast furnaces.

To the above total for 1902 must be added 59,099 tons of Bessemer rails made in the same year from purchased blooms and from rerolled and renewed Bessemer steel rails, making a grand total for 1902 of 2,935,392 tons of Bessemer steel rails. Twenty plants rolled or renewed Bessemer steel rails in 1902, of which 6 were located in Pennsylvania, 3 in Maryland, 5 in Ohio, and 2 in Illinois, and 1 was located in each of the States of New York, Wisconsin, Colorado, and Wyoming.

The production of open-hearth steel rails in the United States in 1902 was 6,029 tons, against 2,093 tons in 1901 and 1,333 tons in 1900. The maximum production of open-hearth rails was reached in 1881, when 22,515 tons were made. The rails rolled in 1902 were made in Pennsylvania and Alabama, the latter producing over five-sixths of the total quantity made.

Of the rails produced in 1902, 261,887 tons were under 45 pounds to the yard, 204,884 tons were over 45 and less than 85 pounds, and 645,162 tons were 85 pounds and over. The total 85 pounds and over in 1901 was 493,822 tons; in 1900, 602,058 tons; in 1899, 579,524 tons; in 1898, 453,210 tons, and in 1897, 335,561 tons.

Imports of iron and steel rails in 1902 were 63,522 tons and exports were 67,666 tons. In 1901 imports were only 1,905 tons while exports were 318,956 tons.

Production of Structural Shapes.

The statistics of iron and steel structural shapes embrace the production of beams, beam girders, zee bars, tees, channels, angles, and other structural forms, but they do not in-

clude plates or girders made from plates. Plates are provided for under other classifications, and in the general statistics of plates are included all plates cut to specifications. Practically all the structural shapes and plates used for structural purposes are made of steel. The total production of strictly structural shapes in 1902 was 1,300,326 tons and in 1901 it was 1,013,150 tons. The production of structural shapes in 1901 and 1902 by States was as follows:

States—Gross tons	1901	1902	States—Gross tons	1901	1902
Maine, New York and New Jersey	51,002	52,554	Illinois, Colorado, and California	5,700	18,762
Pennsylvania	925,940	1,178,760			
Delaware, Ala., and Ohio	30,508	50,250	Total	1,013,150	1,300,326

The increased production of structural shapes in 1902 as compared with 1901 amounted to 287,176 gross tons, or over 28 percent. Pennsylvania made over 90 percent of the total production in 1902, against over 91 percent in 1901; Ohio over 3.7 percent, against almost 3 percent in 1901; and New Jersey almost 3 percent, against over 3 percent in 1901. No other State made 1.5 percent of the total production in either year. In 1900 the production of structural shapes amounted to 815,161 tons, against 850,376 tons in 1899, 702,197 tons in 1898, 583,790 tons in 1897, 495,571 tons in 1896, and 517,920 tons in 1895.

Production of Wire and Cut Nails.

The production of iron and steel wire rods in the United States in 1902 amounted to 1,574,293 gross tons, against 1,365,934 tons in 1901, 846,291 tons in 1900, and 1,036,398 tons in 1899, showing an increase of 208,359 tons in 1902 as compared with 1901. Of the total production in 1902, 1,574,087 tons were steel rods.

The production of wire nails in the United States in 1902 amounted to 10,982,246 kegs of 100 pounds, as compared with 9,803,822 kegs in 1901, an increase of 1,178,424 kegs, or over 12 percent. In 1900 the production amounted 7,233,979 kegs, in 1899 to 7,618,130 kegs, in 1898 to 7,418,475 kegs, in 1897 to 8,997,245 kegs, in 1896 to 4,719,860 kegs, and in 1895 to 5,841,403 kegs. The wire nails produced in 1902, nearly all made of steel, were made by 62 works, as compared with 61 in 1901, 56 in 1900, and 59 in 1899. The following table gives the production of wire nails in 1900, 1901, and 1902, in kegs of 100 pounds:

States—Kegs of 100 pounds.	1900	1901	1902
N. H., Mass., R. I. and Conn	212,584	71,553	309,651
New York	63,466	136,118	132,854
Pennsylvania	2,158,399	3,118,508	4,219,604
Md., West Virginia, Ky., Ala. and Ohio	2,516,391	3,633,894	3,251,918
Indiana and Illinois	2,195,672	2,716,748	2,902,006
Michigan, Wisconsin and California	87,467	127,001	166,213
Total	7,233,979	9,803,822	10,982,246

The statistics of the production of iron and steel cut nails and cut spikes do not embrace railroad and other spikes made from bar iron, wire nails of any size, machine-made horseshoe nails, cut tacks, or hob, clout, basket, shoe, or other small sizes of nails. Spikes cut from plates are included with cut nails. The total production of cut nails in 1902 was 1,633,762 kegs of 100 pounds each, against 1,542,240 kegs in 1901, an increase of 91,522 kegs, or almost 6 percent. In 1886 the maximum production of 8,160,973 kegs was reached. In 1902 the production of wire nails exceeded that of cut nails by 9,348,484 kegs, in 1901 by 8,261,582 kegs, in 1900 by 5,660,485 kegs, in 1899 by 5,713,790 kegs, in 1898 by 5,846,254 kegs, and in 1897 by 6,890,446 kegs. Of the total for 1902 Pennsylvania furnished 752,729 kegs of cut nails; West Virginia and Indiana, 271,362 kegs; Illinois, Maryland, Virginia and Kentucky, 304,990 kegs.

Production of Plates and Sheets.

The production of plate and sheet iron and steel in the United States in 1902, excluding nail plate, amounted to 2,665,409 gross tons, against 2,254,425 tons in 1901, an increase of 410,984 tons, or over 18 percent. Skelp iron and steel are not included in our statistics of plates and sheets but are classed with bars, hoops, etc. The following table gives the production by States of all kinds of plates and sheets in 1901 and 1902, in gross tons:

States—Gross tons	1901	1902
New England	416	4,394
New York and New Jersey	6,512	4,846
Pennsylvania	1,572,500	1,808,207
Delaware and Maryland	29,484	34,282
West Virginia	31,928	67,072
Kentucky and Alabama	47,503	56,823
Ohio	294,266	404,902
Indiana, Ill., Mich., Mo., Wis., Col. and Cal.	271,816	284,883
Total	2,254,425	2,665,409

The production of "black plates for tinning" alone in 1902, which is included above, was 365,743 gross tons, against 398,026 tons in 1901, a decrease of 32,283 tons, or over 8 percent. Of the production in 1902 Pennsylvania made over 48 percent, against over 49 percent in 1901. Ohio, Indiana, West Virginia, Maryland, Illinois, Michigan, and Missouri also made black plates for tinning in 1902 in the order named.

Production of Tin Plates and Terne Plates.

The duty on tinplates and terne plates provided for in the tariff act of 1890 went into effect on July 1, 1891. From that date until the close of the fiscal year ending on June 30, 1897, the statistics of our production of tinplates and terne plates were regularly collected for the Treasury Department by the late Col. Ira Ayer, special agent. From the data thus obtained and from other sources of information we have prepared the following table of our production of tinplates and terne plates in the calendar years 1891 to 1901. We have added an estimate of the production in 1902, but in a short time we hope to have definite figures for that year. The production of tin dipping plants is included in all the figures that are given.

Calendar years	Gross tons	Calendar years	Gross tons
1891 (last six months)	999	1897	256,598
1892	18,803	1898	326,915
1893	55,182	1899	360,875
1894	74,260	1900	302,665
1895	113,666	1901	399,291
1896	160,362	1902 (estimate)	366,000

Production of all Rolled Iron and Steel.

By the phrase rolled iron and steel are included all iron and steel rolled into finished forms, as follows: (1) all sizes of iron and steel rails; (2) plate and sheet iron and steel; (3) iron and steel plates for cut nails and cut spikes; (4) wire rods; (5) iron and steel structural shapes; (6) bar, bolt, hoop, skelp, rolled axles, fish plates, rolled armor plate, and other rolled products. Forged armor plate, hammered axles, and other forgings are not included, nor such intermediate rolled forms as muck bars, billets, and tinplate and sheet bars.

The production of all iron and steel rolled into finished forms in the United States in 1902 was 13,944,116 gross tons, against 12,349,327 tons in 1901, an increase of 1,594,789 tons, or almost 13 percent. Twenty-six States rolled either iron or steel or both iron and steel in 1902, the same number as in 1901. The following table gives the total production by States of rolled iron and steel in 1901 and 1902, in gross tons.

States Gross tons	1901	1902	States Gross tons	1901	1902
Me. and Mass.	165,100	173,463	Ohio	1,566,986	2,019,952
R. I. and Conn.	48,043	95,200	Indiana	399,707	415,049
New York	182,948	181,443	Illinois	1,442,163	1,636,806
New Jersey	143,367	139,310	Michigan	103,063	89,297
Pennsylvania	6,962,668	7,642,636	Wisconsin	181,867	232,752
Delaware	58,242	61,409	Missouri	37,182	64,741
Maryland	301,448	339,773	Col. and Wy.	197,980	200,771
Virginia	29,026	41,329	Wash., Ore., and Cal.	32,152	35,357
West Virginia	201,264	247,812			
Kentucky	156,506	170,320			
Tenn. and Ga.	30,214	25,398			
Alabama	109,391	131,298	Total	12,349,327	13,944,116

Pennsylvania made almost 55 percent of the total production of rolled iron and steel in 1902, against over 56 percent in 1901; Ohio over 14 percent, against over 12 percent in 1901; Illinois over 11 percent in each year; and Indiana almost 3 percent, against over 3 percent in 1901. No other State made 2.5 percent in either year. Minnesota and Kansas, both of which States have rolling mills, did not produce any rolled

iron or steel in 1901 or 1902, but Minnesota made a small quantity of direct steel castings in both years.

Total Production of Rolled Iron and Steel.

The total production of all kinds of iron and steel rolled into finished forms in the United States from 1887 to 1902 is given below:

Years, Gross Tons	Iron and Steel Rails	Bars, Hoops, Skelp and Shapes	Wire Rods	Plates and Sheets, except Nail Plate	Cut Nails, Gross Tons	Total, Gross Tons
1887	2,139,640	2,184,279	.....	603,355	308,432	5,235,706
1888	1,403,700	2,094,162	279,769	609,827	289,891	4,617,349
1889	1,522,204	2,374,968	363,851	716,496	259,409	5,236,928
1890	1,889,307	2,618,660	457,099	809,981	251,828	6,022,875
1891	1,307,176	2,644,941	536,607	678,927	222,312	5,390,963
1892	1,551,844	3,033,439	627,829	751,460	201,242	6,165,814
1893	1,136,458	2,491,497	537,272	674,345	136,113	4,975,685
1894	1,021,772	2,155,875	673,402	682,900	108,262	4,642,211
1895	1,306,135	3,006,765	791,130	991,459	95,085	6,189,574
1896	1,122,010	2,731,932	623,986	965,776	72,137	5,515,841
1897	1,647,892	3,081,760	970,736	1,207,286	94,054	7,001,728
1898	1,981,241	3,941,957	1,071,683	1,448,301	70,188	8,513,370
1899	2,272,700	4,996,801	1,036,398	1,903,505	85,015	10,294,419
1900	2,385,682	4,390,697	846,291	1,794,528	70,245	9,487,443
1901	2,874,639	5,788,479	1,365,934	2,254,425	68,850	12,349,327
1902	2,947,933	6,683,545	1,574,298	2,665,409	72,936	13,944,116

Production of Allegheny County, Pa.

The following table gives the number of built and building blast furnaces and completed rolling mills and steel works, and the production in gross tons of pig iron and crude steel and of iron and steel rails and iron and steel strucural shapes in Allegheny County, Pennsylvania, in the last four years.

Details—Gross Tons.	1899	1900	1901	1902
Furnaces built and building....No.	34	34	37	40
Production of pig iron.....	3,255,678	3,118,761	3,690,011	4,260,769
Rolling mills and steel works, No.	63	61	63	66
Production of Bessemer steel.....	2,606,220	2,318,871	2,883,595	3,094,175
Production of open-hearth steel....	1,470,271	1,680,249	2,199,191	2,503,245
Production of crucible and other steel.....	58,426	52,188	56,053	62,888
Total production of steel.....	4,134,917	4,051,308	5,138,839	5,660,308
Production of all kinds of rails	606,017	631,467	711,031	712,286
Production of structural shapes....	529,979	475,572	617,308	773,144

Allegheny county produced in 1902 almost 24 percent of the total production of pig iron in the United States, against over 23 percent in 1901; almost 34 percent of the total production of Bessemer steel ingots and castings, against over 33 percent in 1901; over 44 percent of the total production of open-hearth steel ingots and castings, against over 47 percent in 1901; over 53 percent of the total production of crucible steel, against almost 57 percent in 1901; almost 38 percent of the total production of all kinds of steel, against over 38 percent in 1901; over 24 percent of the total production of all kinds of rails, against 24.7 percent in 1901; over 59 percent of the total production of structural shapes, against over 60 percent in 1901; and over 32 percent of the total production of all kinds of rolled products, against over 32.3 percent in 1901.

Westinghouse, Church, Kerr & Co. have recently secured orders for additional boiler and economizer equipments for the Detroit plant of the Solvay Process Co. This company operates at Detroit and Syracuse, N. Y., two large chemical establishments. The Detroit plant is located at Delray, a suburb, and near the enormous salt deposits occurring in the marshland at this point. Steam power is furnished from a central boiler plant, which at present aggregates 7,200 h. p., Roney mechanical stokers are used, and the several batteries of boilers are also equipped with Roney high pressure circulating type economizers. The plant is laid out in batteries of six boilers each. The additional equipment will consist of a new battery comprising 6 300 h. p. Babcock & Wilcox water tube boilers fitted with Roney stokers, together with four additional economizers, two of which will complete the equipment of a previously installed battery. A conspicuous feature of this plant is a massive brick stack 16 feet in diameter and 260 feet high.

The American Locomotive Co. has secured a contract from the Mexican Central Railroad for forty-eight locomotives, of which thirty-seven will be consolidated type, six mogul passengers and the rest switching engines.

INDUSTRIAL SUMMARY.

[If you are in need of machinery of any description, please notify *The Iron Trade Review*, and we will put you in communication with our advertisers at once.]

New Buyers in the Market and Some of Their Wants:—

The Burt Machine Co., Baltimore, Md., has been incorporated to manufacture canning machinery, capital $50,000.

The Pittsburg Piping & Equipment Co., Pittsburg, capital $50,000, has been incorporated.

The Standard Steel Tube Co., Toledo, O., has been incorporated with a capital of $60,000. Incorporators are: E. C. Lee, W. P. Tyler, B. S. Hamilton, O. A. Lee and R. J. West.

The Wright Reverse Co., Pittsburg, has been incorporated under the laws of West Virginia for the purpose of manufacturing the Wright Reverse clutch and other machinery. The capital stock is $100,000.

The Mono-Metal Production Co. has been organized at Defiance, O., to manufacture dredging machinery. Directors are: H. P. Miller, H. K. Reynolds, J. W. Lynde, Dr. John J. Stitt, of Rising Sun, O.; Cyril Barbeau, of Tiffin, O.; Philip Lawrence, of Huron, S. Dak., and R. H. Gleason.

The West Lafayette Stamping & Enamel Co., Coshocton, O., has been organized with D. A. Raiff, president; W. H. Sweeney, vice president; John Kirk, secretary; Harvey Sicker, treasurer; directors, D. A. Raiff, W. H. Sweeney, H. R. McCurdy, Edward Leretilley, Chas. Miller and William Gorseline. The capitalization is $50,000, and the company will employ 100 men.

The Flexwelt Shoe & Machinery Co. has been reorganized at Augusta, Me., with a capital of $1,000,000, all of which is paid in. The directors are: Wallace B. Phinney, Jacob F. Frost and John Callahan, all of Lynn, Mass.

The W. M. R. Wood Improved Wheel Co., St. Louis, Mo., has been incorporated with a capital of $250,000.

The Sheet Metal Specialty Mfg. Co., Detroit, has been incorporated with a capital of $30,000.

Wausau Foundry & Machine Shops, Wausau, Wis., has been incorporated with a capital of $25,000.

The White Iron Coke Iron Co., with headquarters at Duluth, Minn., capitalized at $50,000, has been incorporated.

The Northern Indiana Machine & Electrical Co., capital $5,000, South Bend, Ind., has been incorporated for the purpose of manufacturing and dealing in electric light machinery and appliances.

The National Automatic Weighing Co., of Mount Kisco, Westchester County, N. Y., has been incorporated to continue the business of the American Automatic Weighing Machine Co., of London, England, and the National Automatic Weighing Machine Co., of New York. The capital is $1,350,000, and the directors are: Robert S. Huz, Lyda H. Gardner, Adelbert W. Bailey, John Brandt, Charles R. Hutton, of New York.

The Chicago Car & Locomotive Works, Chicago, capital $100,000, has been incorporated to manufacture railway cars and locomotive parts.

A charter has been granted to the Morgan Wood & Iron Works, Spartanburg, N. C., capital being $40,000. William M. Jones is president and treasurer and W. S. Montgomery is secretary.

The H. S. French Machine Co., Cleveland, capital, $50,000, has been incorporated by Harry S. French, W. E. Marshall, H. C. Komraus, Wm. F. Gruettner, Frank J. Man.

It is reported that a number of Ft. Wayne (Ind.) capitalists have formed a company to be known as the Gas Engineering Co. The company has purchased a site and taken out a permit for the erection of a large plant in Collinwood, O. Several hundred hands will be employed in the manufacture of gas engines.

New Construction:—

The Acme Foundry Co., Detroit, has purchased a site having a frontage of 226 feet by 152 in depth, on which a modern foundry building, 75 by 75 feet, will be erected. The officers of the company are: President, Edward J. Woodison; secretary, Fred G. Christian; treasurer, William Kahl.

The Sylvan plant of the Republic Iron & Steel Co., at Mo-

line, Ill., has been closed down for extensive repairs. When the wheels are again in motion, the new 8-inch mill will be in operation. Last fall the company decided that the old mill should be entirely reconstructed, and this plan is being carried out.

The new addition to the Colton foundry, Galesburg, Ill., is now nearly complete. About 60 men are employed and the force will be increased in the future.

The Southern Railway will within a few days begin the construction of shops in that part of Louisville, Ky., known as Youngstown. The improvements will cost about $500,000. In addition to building the shops, the railroad will construct a large number of tracks, which will afford storage room for all the coaches and freight cars of the line which are not in active service. The plan of making Louisville the place for repairing all the rolling stock has been under consideration by the Southern Railway for several years. The repair shops, although not as large as those proposed by the L. & N. Railroad, will be large enough to carry on the repairs for all cars and locomotives, and will give employment to several hundred men.

The work of reconstructing the W. De Wees Wood plant, at McKeesport, Pa., by the American Sheet Steel Co., is now in operation. When completed the works will have cost $2,500,000, and will give employment to at least 400 additional men. The old frame building will be replaced by a steel and corrugated iron structure, which will be fireproof. Nine sheet mills will be elevated from fifteen to twenty feet high above the floods of the Monongahela. Seven mills will be erected in the newly built addition and connected with the mill proper by a trolley line recently placed in operation within the Wood mills. Two modern new sheet mills will be erected on property purchased a few weeks ago. A new roll turning house is provided with an electric traveling crane that will enable the changing of rolls within fifteen minutes.

The E. J. Manville Machine Co., Waterbury, Conn., has purchased a site and has plans for the erection of a new plant. The machine shop proper will be two stories, of brick, 50 x 320 feet. Another brick building, three stories high will be 40 x 120 feet. Three minor buildings will also be erected.

H. L. Hough and other citizens of Pittsburg have purchased a farm of 75 acres near Greensburg, Pa., and it is reported that a large foundry and machine shop will be erected thereon.

The Eastern Steel Co., Pottsville, Pa., has decided to build two more open-hearth furnaces in connection with the four which are already in the course of construction. This will increase the estimated annual output of steel from 125,000 to 175,000 tons.

The Sterling Wrench & Tool Co., Dixon, Ill., has decided to push the erection of its new plant as soon as funds are forthcoming. The directors report that the outlook for business is very favorable.

The S. M. Jones Co., Toledo, O., has purchased a 15½-acre tract and will soon begin the erection of a $30,000 steel and brick plant for the manufacture of gas engines.

Nearly all the workmen employed by the Westinghouse Mfg. Co. in the erection of its plant at Attica, N. Y., have been laid off. This is done on account of the uncertainty of the company procuring iron and steel for the construction.

The Anderson Steel & Wire Co., Anderson, Ind., has closed its mills for a month. Extensive improvements are being made and new engines are being installed.

Fay & Scott, Bangor, Me., are building an addition to their foundry which will be completed at the earliest possible day.

The Cleveland City Forge & Iron Co., Cleveland, is about to erect a two-story addition to its machine shop, one steel structure 70x200 feet and one brick and steel structure 70x120 feet. The Garry Iron & Steel Co. has the contract for the steel work in the first building.

Fires and Accidents:—

Among the losses resulting from the flood July 5 at Jeannette, Pa., are the following: National Carbon Co., Cleveland, $25,000; Pennsylvania R. R. Co., $50,000. Among the losses at Penn and Irwin, Pa., were: Pennsylvania R. R. Co., $94,000; Hockensmith Wheel & Mine Car Co., $10,000; Pittsburg, McKeesport & Greensburg St. R. R. Co., $35,000.

The breaking of a spur wheel, followed by the letting go of the fly wheel on the massive Corliss engine which drives the entire cold rolling department of the Singer-Nimick plant of the Crucible Steel Co., Pittsburg, wrecked the mill building, a house across the street, a passing wagon and almost caused loss of life. The damage by the accident will be about $15,000.

General Industrial Notes:—

The board of trade, Carnegie, Pa., has decided to take a large amount of stock in the George A. Hogg Iron & Steel Foundry Co., which will probably build a large plant in Carnegie this year. A farm at Rosslyn Station has already been optioned.

The old steel plant known as the Henderson steel works, located at North Birmingham, Ala., has been sold to the Union Iron & Steel Co.

The plant of the Terre Haute Shovel & Tool Co., Terre Haute, Ind., has been sold to the Acme Shovel & Tool Co. Only the machinery was sold, the company still retaining the buildings and ground.

The Salem, O., plant of the American Steel & Wire Co. has been reduced to a single turn, night work having been temporarily abandoned.

The board of trade, Vincennes, Ind., has closed a contract with the Eads Tool Co. for the erection of a universal tool factory in that city.

M. Garland, of the M. Garland Co., has purchased the entire Smalley Bros. & Co machine shops and foundry located on Saginaw St., Bay City, Mich.

The buffing and polishing wheel works of the Devine Bros. Co., New Hartford, N. Y., will be moved to Syracuse, N. Y., in a few weeks. The capital stock of the company is $20,000, and the floor space now occupied is 12,000 square feet. In Syracuse it expects to have about 25,000 square feet. About 200 men will be employed.

The Lodi Steel Box Co., Defiance, O., has been reorganized under the laws of Delaware with a capital stock of $70,000 and its name changed to the American Steel Package Co.

Birmingham has been made the southern headquarters of the Detroit Stove Works, of Detroit and Chicago. W. A. Gibbons, of Chicago, has been placed in charge.

The old Standard machine shop, which was one of the first in Winnipeg, Man., has been dismantled, and the plant removed to another site in the same city, where it has new shops, the largest and most complete in Western Canada.

The American Iron Mining Co., of Cleveland and Marquette, has filed amended articles of incorporation renewing its corporate existence, which was about to expire. The company has $500,000 capital.

The new power house of the Tennessee Coal, Iron & Railroad Co., of Ensley, Ala., is now finished. It was built by the company to furnish more power, rendered necessary by the large addition to the rail mill and steel plant. The company has installed much new machinery in the steel plant in the last two or three months. The capacity of the rail mill has been increased about 20 percent.

The Standard Engineering Co., Cleveland, recently incorporated, will do a general contracting and engineering business, making a specialty of electric railway construction, electric power and lighting plants, developing of water power, etc., and maintaining a competent engineering department to superintend and supervise the construction and improvement of all such classes of work. In addition the company is prepared to superintend the construction of improvements in river and harbor work, and all classes of municipal work.

The firm of J. K. Wilder & Sons of Monroe, Mich., manufacturers of feed and ensilage cutters, wind elevators, horse powers, land rollers, clod pulverizers and soil packers and a general line of agricultural implements, have been succeeded by a new corporation known as the Wilder-Strong Implement Co., organized under the laws of Michigan. The capital stock is $50,000. The officers are the following: Wm. H. Strong, president; J. K. Wilder, vice president; E. S. Wilder, secretary and treasurer. Wm. H. Strong, the new member of the firm, is a well known business man of Detroit. The company will continue to manufacture the lines of goods formerly made by J. K. Wilder & Sons, but with added capital and the added energy of the new member of the firm, is planning to double its former output.